REPORT

on implementation of milestones of the 4 quarter of the third year
of the Joint Ukrainian-American Scientific Project

«Study of Thyroid Cancer and Other Thyroid Diseases in Ukraine Following the Chornobyl Accident»

Project Manager Dr. M. Tronko

(March - May 1999)

1. Management and administration

1.14 To ensure further screening examinations of cohort members residing in Kozelets raion of Chernihiv oblast on the basis of the Clinic of the Institute of Endocrinology by fixed medical team.

Fixed medical team has performed on the basis of the Clinic of the Institute of Endocrinology and Metabolism of the AMS of Ukraine screening examinations of cohort members who are residing in Kozelets raion of Chernihiv oblast. A total of 327 participants have been examined. This form of screening was found to be more advantageous from economic standpoint as compared to the expenses necessary for mobile medical teams' functioning, and also more effective, allowing to examine 20 to 25 cohort members daily. In order to promote the introduction of this form of screening, Prof. M.D. Tronko, Project Manager, has applied to Dr. R.V. Bogatyryova, Minister of Public Health of Ukraine with a request to support the Institute in acquiring a coach (for 30 - 40 seats) for transport of screening participants from controlled raions to the Clinic of the Institute for screening.

The Minister Dr. R.V. Bogatyryova supported the request of Prof. M.D. Tronko and, in turn, she applied with the same request to Mr. V.A. Smoliy, Deputy Prime-Minister of Ukraine, who has submitted this issue for consideration of Mr. V.V. Durdynets, Minister of Ukraine for the emergency situations and protection of the population against the consequences of the Chornobyl accident, and Mr. I.O. Mityukov, Minister of Finances of Ukraine, and asked them to promote, as far as possible, the solution of this problem.

1.18 To organize screening examinations by mobile medical teams, of cohort members residing in Chernihiv raion of Chernihiv oblast

Screening examinations by mobile medical teams of cohort members residing in Chernihiv raion of Chernihiv oblast have been organized·361 participants have been examined.

1.19 To organize screening examinations by mobile medical teams, of cohort members residing in Repky raion of Chernihiv oblast

Screening examinations by mobile medical teams of cohort members residing in Ripky raion of Chernihiv oblast have been organized 460 participants have been examined.

1.20 To establish contacts with theMain Departments of the Ministry of Internal Affairs of Ukraine, of Zhytomyr and other oblasts of Ukraine concerning implementation of the instructions No. 10/6-4680 of the Ministry of Internal Affairs of Ukraine dated November 30, 1998.

Contacts have been established with the Main Departments of the Ministry of Internal Affairs of Ukraine in Chernihiv and Zhytomyr oblasts, and City of Kyiv (Departments of passport registration and migration issues). As a result of the work performed, the addresses of 2500 potential cohort members have been additionally established: for Chernihiv oblast 1300 participants; for Zhytomyr oblast 600 participants; for the City of Kyiv 600 participants.

1.21 To organize and hold a regular joint meeting devoted to issues of Project implementation (with participation of the Ministry of Public Health of Ukraine, Project's Management and executors.

Because of a staff meeting planned by the Minister of Public Health for July 26, 1999, with hearing the account on Project implementation and involvement of all executors and coexecutors, the regular joint meeting devoted to the issues of Project implementation was adjourned till July 1999.

1.22 To organize and hold a meeting with medical staff of controlled raions, who are responsible for searching cohort members and their involvement in screening examinations.

Meetings have been held with medical workers of controlled raions of Chernihiv and Zhytomyr oblasts, who are responsible for search of cohort members and their involvement in the screening.

1.23 To prepare custom clearance documentation for shipments received in the framework of the Project.

Custom clearance documentation for reagents and supplies received within the reported period, has been prepared.

2. Establishment of the cohort

2.11 *To continue identifying settlements with substantial number of patients, resettled from contaminated areas, and clarify the possibilities of their examining.*

In the process of address search of the cohort members, settlements outside of the study raions with large numbers of cohort members were determined. Currently 902 cohort members are known to dwell in Kyiv. We know mailing address of 413 persons resettled to Kyiv from Chernobyl and Prypyat; for the remaining 489 persons address needs to be clarified.

A list has been addressed to the Kyiv City Passport Office, consisting of 489 cohort members who, as it was learnt from the results of manual search in the study raions, moved to Kyiv. Their mailing address remains unknown and will be clarified in the process of this search. A list has been also addressed to the Kyiv Passport Office, including 4041 persons, not found in Polisya, Chornobyl and Ivankiv raions and Town of Prypyat of Kyiv oblast, in order to determine how many of them were resettled to Kyiv. This work will be finished in the next quarter.

2.12 *To perform address search of possible cohort members, resettled from Chornobyl and Chornobyl raion, Prypyat and Polisya raion, to different oblasts of Ukraine and to Kyiv oblast using card index of the Chornobyl Department of Kyiv oblast.*

Search of people, resettled from Chornobyl and Prypyat in the Chernobyl Department of Kyiv oblast, has been started. Up to date, addresses for 261 cohort members out of 1220 people from Prypyat, whose address was unknown, have been found.

Out of them 84 persons moved to Kyiv, 26 persons are dwelling in Kyiv oblast. Address information obtained from this particular data source is valid for 1991 year.

2.13. *To use the data of raion passport offices for search of people not found in the raions under study.*

Data about current situation with address identification presented in tables 1 and 2.

Address search in Chernihiv oblast.

Address search has been performed in the passport office of Chernihiv oblast, of 2142 cohort members not found by manual search in Chernihiv oblast. Out of them:

780 are cohort members who used to live in the City of Chernihiv in 1986 and have been not found in the process of manual search in the policlinics of the raion.

433 moved to the City of Chernihiv according to the results of manual search in the raions of Kyiv oblast.

929 are not located cohort members, out of those who previously lived in Ripky, Kozelets and Chernihiv raions.

The following address information has been obtained:

607 cohort members are currently living in the City of Chernihiv.

363 - live within Chernihiv oblast.

46 – moved out of the oblast.

10 persons – have emigrated.

4 - have died.

Address search in Ripky raion.

Address search has been performed in the raion passport office among those cohort members (306) who were not found during manual search in raion policlinics. In the process of invitation for screening it has been found that a certain part of people changed their status since that time when information about manual search has been received. Situation with the address location in the raion is presented in Table 3.

Address search in Zhytomyr oblast.

Address search of the cohort members who have not been found, is being performed in Zhytomyr oblast using card indexes of oblast passport office and raion passport offices. A list of 1600 cohort members who had not been found in the study raions, has been addressed to the oblast and raion passport offices.

Address Search in Kyiv oblast.

Lists of cohort members not found in Polisya (1385 people) and Chornobyl (1340 people) raions of Kyiv oblast have been addressed to the passport offices of all raions of Kyiv oblast in order to find cohort members resettled to these particular raions.

There is some restrictions for location of cohort members with the help of passport offices. People younger than 16 years old could not be located, they are not registered in this particular data source.

Table # 1

Identification Of Current Address of 1986 Cohort

Study rayon	Total In 20,000 Cohort in 1986	Total Living Identified	%	Decease d	%	Dublicate records	%	Moved to unknown address	%	Not found	%
Town of Pripriat	1584	361	23%	0	0%	11	1%	0	0%	1212	77%
Polessky	1399	9	1%	0	0%	5	0%	0	0%	1385	99%
Ivankiv	737	592	80%	2	0%	15	2%	24	3%	104	14%
Chornobyl	1484	130	9%	0	0%	14	1%	0	0%	1340	90%
Kozelets	2089	1334	64%	9	0%	17	1%	121	6%	608	29%
Ripkinsky	1377	1085	79%	13	1%	41	3%	48	3%	190	14%
Chernihiv	2858	1999	70%	15	1%	147	5%	240	8%	457	16%
City of Chernihiv	1192	446	37%	0	0%	1	0%	16	1%	729	61%
Narodychi	4279	2735	64%	10	0%	816	19%	5	0%	713	17%
Ovruch	3072	2065	67%	10	0%	6	0%	151	5%	840	27%
Total	20071	**10756**	53%	59	0%	1073	5%	**605**	3%	7578	38%

Table # 2

Status of Cohort with Identified Current Addresses

Study rayon	Total living Identified	Total living in rayon	%	Living in the same oblast	%	Living in other oblast	%	Emigrated	%	Temporarily absent	%
Town of Pripriat	361	0	0%	360	100%	0	0%	0	0%	1	0%
Polessky	9	0	0%	9	100%	0	0%	0	0%	0	0%
Ivankiv	592	508	86%	60	10%	18	3%	2	0%	4	1%
Chornobyl	130	47	36%	83	64%	0	0%	0	0%	0	0%
Kozelets	1334	976	73%	86	6%	171	13%	19	1%	82	6%
Ripkinsky	1085	711	66%	192	18%	50	5%	76	7%	58	5%
Chernihiv	1999	1463	73%	392	20%	79	4%	25	1%	40	2%
City of Chernihiv	446	444	100%	1	0%	0	0%	1	0%	0	0%
Narodychi	2735	912	33%	1108	41%	624	23%	35	1%	16	1%
Ovruch	2065	1728	83%	67	3%	188	9%	76	4%	6	0%
Total	10756	6789	63%	2358	22%	1130	10%	234	2%	205	2%

Table 3. Address identification in Ripki rayon.

Source of information	Namber of people searched	Status was determined or changed	Percent from the number of people in cohort in the rayon	Found in the Ukraine	Percent from the number of cohort members in rayon	Found and live in the rayon	Percent from the number of people in cohort in the rayon	Emigrated	Temporalily absent	Double records	Died	Moved in unknown direction	Without mailing address
Manual search in Ripki policlinic	1377*	1125	82	889	64	667	48	64	43	39	11	54	25
Manual search in Ripki passport office	306 **	74	5	68	5	25	2	3	1	2	0	0	0
Learnt during invitation for screeneng	932***	48	3	12	1	3	1	4	17	0	2	11	2
All sources	1377			923	67	715****	50	76	56	41		48	

*all cohort members in the rayon
** after manual search in policlinics were not found or moved to unknown direction
*** found or temporalily absent cohort members in the rayon, changed their status after being found by manual search.
**** 20 persons moved to rayon from other study rayons

3. Invitation of patients for endocrinologic screening

3.10. *To perform repeated invitation to screening of the study subjects currently living in Ovruch raion of Zhytomyr oblast.*

For repeated invitation to screening 1290 invitations have been distributed to the cohort members in Ovruch raion, who are known to live in the raion but were not examined earlier.
A schedule for screening of people will be established based on the answers received.

3.12 *To continue obtaining and analysing information on persons who did not come for examination in all raions under study where examination already took place (Ovruch raion of Zhytomyr oblast, Narodychi raion of Zhytomyr oblast, Kozelets raion of Chernihiv oblast. Chernihiv raion of Chernihiv oblast).*

In all raions where examination took place lists of people found but not examined, have been delivered in order to clarify the reasons of refusal or not coming for screening and to learn the possibility of their repeated invitation to screening.
Ovruch raion – 1290 persons,
Narodychi raion – 571,
Kozelets raion – 364
Chernihiv raion – 1102.
In Ovruch and Narodychi raions written repeated invitations to screening have been distributed.

3.13 *To perform repeated invitation for screening in Ivankiv raion taking into account new address information*

During examination which took place in Ivankiv raion of Kyiv oblast in April – May 1998, it has been examined 147 persons out of the cohort members living in Ivankiv raion of Kyiv oblast in 1986 (24 %) from the total number of people found. Also, 37 persons came for screening from that part of former Chornobyl raion, which presently belongs to Ivankiv raion. Up to date at the Institute there is information that 508 cohort members out of the 737 members of Ivankiv part of 1986 cohort.

Additionally, in the process of manual search in other raions it has been found out that 22 persons moved to Ivankiv raion and live there. According to our data, 530 persons are living now in Ivankiv raion. Repeated invitation to screening in the raion has started. 406 invitations have been distributed in the raion. According to the answers received, a schedule of examinations will be established.

3.14 *To invite for screening examination by fixed examining center of cohort members in Kozelets raion of Chernihiv oblast, who gave their consent to participate.*

For screening by mobile team, cohort members from Kozelets raion have been invited, who agreed to participate in the study. A schedule for examination has been established by local medical staff. 408 appoimtments have been made, 327 persons came for screening. Cohort members in the raion received written invitations.

3.15 *To invite for examining patients currently living in Chernihiv raion and who agreed to participate in the Project.*

For examining by mobile team were invited 1498 cohort members from Chernihiv rayon. Written invitations were handed to all found cohort members in the rayon. 361 cohort members were invited.

3.16 *To obtain agreement to participate in the study from patients living in the Ripky raion of Chernihiv oblast.*

In Ripki rayon of the Chernihiv oblast were distributed 743 invitations.
Were made 578 appointments attended by 460 cohort members (61%)

Tabl 4 Screening activities in the 4th quarter.

	Raion	**Appointments made**	**Screened**	**%**
Fixed team	Kozelets	408	327	80
Mobile teams	Cernihiv	530	361	68
	Ripky	578	460	79

	City of Chernihiv	220	184	83
		1691	1332	76

Tabl.5 Number of people screened for the 01.06.1999

1	Raion	Totally in 20000-cohort	Found and live in raion	Were examined		
				N	% of number of found	% of number of members of 20000-cohort
1	Ivankiv	747	508	145	28	19
2	Former Chornobyl raion, Gornostaipil Village Council	84	47	37	-	44
3	Ovruch	3073	1728	770	42	25
4	Narodychi	4277	912	426	43	10
5	Kozelets	2089	976	612	53	29
6	Kyiv	-	412	333	81	-
7	Brusyliv	-	89	67	75	
8	Chernihiv	2857	1463	361	24	13
9	Ripky	1377	711	460	46	30
10	City of Chernihiv	1192	444	184	45	15
Total			7290	3395		

Information to be returned to examined cohort members about final medical conclusions and results of laboratory tests have been prepared.

Rayon	Number of conclusions prepared
Ovruch	668
Narodichy	77
Kozelets	53
Ivankiv	138
Kyiv	129
Total	1065

4. Endocrinologic examination of the subjects

4.6 To perform screening by mobile teams of cohort members residing in Ripky and Chernigov raions of Chernigov oblast.

4.7 To perform screening by fixed team, on the base of the Institute of Endocrinology and Metabolism, of cohort members residing in Kozelets raion of Chernihiv oblast.

A total of 1246 persons have been examined in Zhytomyr, Chernihiv oblasts and City of Kyiv (persons who had been evacuated from the Town of Prypyat in May 1986).

It has been revealed:

Diffuse goiter, degree 1 -	128 cases
Diffuse goiter, degree 2 -	17 cases
Mixed goiter, degree 1 -	6 cases
Mixed goiter, degree 2 -	5 cases
Nodular goiter, degree 1 -	6 cases
Multinodular goiter, degree 1 -	3 cases
Multinodular goiter, degree 2 -	1 case
Autoimmune thyroiditis:	
atrophic form -	1 case
hypertrophic form -	1 case
Papillary thyroid carcinoma -	3 cases

(the patients Obabko and Bilonozhko with PTC have been operated on in March 1999, the patient (female) Markovich with PTC has been operated on in May 1999).

Final conclusions on the presence of thyroid pathology in the persons examined will be available after obtaining the results of punction cytology of nodular formations, hormonal assays and determination of levels of antibodies to thyroid antigens.

5. Operation of the Central Laboratory

5.2 To perform all laboratory investigations in the process of screening.

I. Blood assays:

1. A total of 1330 Ca^{++} assays have been performed, including:

   1185 cases of normal level;

   117 cases above the normal level;

   28 cases below the normal level.

2. A total of 252 cases of thyrotropin assays have been performed, including:

   246 cases of normal level;

   4 cases above the normal level;

   2 cases below the normal level.

II. 11 biopsies of thyroid neoplasms have been performed, including:

1. 2 cases of papillary carcinoma.
2. 1 case of autoimmune thyroiditis.
3. 2 cases of nodular goiter.
4. 2 cases of adenoma.
5. 2 cases of cystic transformation.
6. 2 cases of blood, colloid.

III. Urinary iodine tests

For the period March-May 1999, urinary iodine excretion tests have been performed in 974 persons examined, who were children and adolescents at the moment of the Chornobyl accident and are living in Kozelets, Ripky, Chernihiv raions of Chernihiv oblast. Investigation of iodine excretion was performed using cerium-arsenite method according to R. Gutekunst technique modified by A.A. Dunn. A urinary iodine excretion under 20 μg/l was reported in 9.3 % of the persons examined; iodine concentration from 20 to 50 μg/l was found in 20.0 % of subjects. Urinary iodine excretion from 50 to 100 μg/l has been revealed in 22.3 % of the persons examined. Iodine excretion over 100 μg/l was reported in 48.4 % of subjects. The results obtained point out a moderate iodine deficiency in persons examined from controlled regions of Ukraine.

6. Operation of Data Coordinating Center

6.19 To develop DB and software for entering the Screening Forms "Results of laboratory blood tests" and "Blood collection Form".

A database and a program for input of "Results of laboratory blood tests" and "Blood collection Form", from paper, have been developed.

Structure of the DB "Results of Laboratory Blood Tests" LabBlood.DB
(* - key fields)

NAME OF FIELDS	TYPE	COMMENTS
IDPAT	A(8)	Patient's ID
IDBL	A(8)	Sample's ID
DATEA1	D	Date of thyroid hormone blood test.
TYPEA11	Byte	1 Type of analysis : 0 – TSH IU/l; 1 – FT4 picomol/l; 2 – Total T4 nanomol/l;
RESAULT11	N	1 Result
NORMLEVEL11	N	1 Normal level (substitution from the reference book of normal levels)
TYPEA12	Byte	2 Type of analysis: 0 – TSH IU/l; 1 – FT4 picomol/l; 2 – Total T4 nanomol/l;
RESAULT12	N	2 Result
NORMLEVEL12	N	2 Normal level (substitution from the reference book of normal levels)
TYPEA13	Byte	3 Type of analysis: 0 – TSH IU/l; 1 – FT4 picomol/l; 2 – Total T4 nanomol/l;
RESAULT13	N	3 Result
NORMLEVEL13	N	3 Normal level
KODVRACH1	S	Code of laboratory physician 1
DATEA2	D	Date of analysis of anti-TPOantibodies in blood
TYPEA21	Byte	1 Type of analysis: 0 – anti-TPO antibodies; 1 – anti-Tg antibodies; 2 – thyroglobulin;
RESAULT21	N	1 Result
NORMLEVEL21	N	1 Normal level
TYPEA22	Byte	2 Type of analysis: 0 – anti-TPO antibodies; 1 – anti-Tg antibodies; 2 – thyroglobulin;

RESAULT22	N	2 Result
NORMLEVEL22	N	2 Normal level
TYPEA23	Byte	3 Type of analysis: 0 – anti-TPO antibodies; 1 – anti-Tg antibodies; 2 – thyroglobulin;
RESAULT23	N	3 Result
NORMLEVEL23	N	3 Normal level
KODVRACH2	S	Code of laboratory physician 2
DATEA3	D	Date of analysis of calcium and albumin contents in blood
TYPEA31	Byte	1 Type of analysis: 0 – calcium mmol/l; 1 – albumin g/l;
RESAULT 31	N	1 Result
NORMLEVEL31	N	1 Normal level
TYPEA32	Byte	2 Type of analysis: 0 - calcium mmol/l; 1 - albumin g/l
RESAULT32	N	2 Result
NORMLEVEL32	N	2 Normal level
KOVDRACH3	S	Code of laboratory physician 3
KOLPROBIR	S	Total number of test tubes left for storing
ZAKLUCHENIE		Conclusion: results of analyses are within the normal range: 0 – YES 1 – NO
NOTESZAK	Memo	Comments to conclusion

21.	TimeSentrifug2	S	Time of centrifugation
22.	Problems2	A(4)	Line with enumeration of problems occurred with the sample
23.	DateCold2	D	Date of placing the sample in the refrigerator
24.	TimeColdH2	S	Time of placing the sample in the refrigerator
25.	TimeColdM2	S	Time of placing the sample in the refrigerator
26.	Kod_Zap2	A(3)	Code of the person having filled in Part 2 of the Form
27.	DateSend3	D	Date of sending the sample to the Central Laboratory
28.	TimeSendH3	S	Time of sending the sample to the Central Laboratory.
29.	TimeSendM3	S	Time of sending the sample to the Central Laboratory
30.	KolProbirSend3	S	Number of test tubes sent
31.	Kod_Zap3	A(3)	Code of the person having filled in Part 3 of the Form
32.	DateReceive4	D	Date of receipt of the sample
33.	TimeReceiveH4	S	Time of receipt of the sample (hours)
34.	TimeReceiveM4	S	Time of receipt of the sample (minutes)
35.	KolProbir4	S	Number of test tubes received
36.	KolProbirNotes4	A(3)	Line with enumeration of problems which may occur when receiving the samples
37.	Kod_Deviler4	A(3)	Code of the person having delivered the samples
38.	Ms_SaveM4	S	Place of storage: freezer №
39.	Ms_SaveP4	S	Place of storage: shelf №
40.	Kod_Zap4	A(3)	Code of the person having filled in Part 4 of the Form
41.	HeadSLab	A(3)	Code of the Head of the Central Laboratory

6.20 To adapt DB and software for operation with LapTop. To establish software for data synchronization.

Since data may be set simultaneously both into centralized (server) part of cohort DB and into local DB variant, which is on portable computer (for example, during search in passport office), the necessity arose to establish software for data synchronization.

A program has been developed for reading data from a portable computer into the main Project DB. All the changes in main Project DB are additionally stated in DB of changes (changes.db) whose recording structure contains the following information: : ID – identification number; Nsource – code of data source; CodeChange – code of change (surname, first name, date of birth, address, etc.); OldValue – old value of DB field; NewValue - new value of DB field.

Thus, all DB changes are stated, and one may follow the history of change (supplementing) of passport information for each cohort member, and from what source information is received (for example, passport office or search by local medical workers).

A parameter is transferred to the data synchronization program: the code of data source in DB (changes.db) which is on a portable computer Laptop, from which information is to be transferred. According to ID и CodeChange - the code of changes in DB (changes.db) - the program introduces changes into the main (server) variant of Project DB. Thus, data from the mobile computer are transferred to the main database.

6.21 To develop DB and software for input of "Preliminary conclusion on the results of screening" Form

A database and a program for input of data from paper "Preliminary conclusion and recommendations of medical screening" have been developed.

Structure of the DB "Preliminary conclusion and recommendations of medical screening" Pred_Zak.db
- reflects information contained in "Preliminary conclusion and recommendations of medical screening".
(* - key fields)

NAME OF FIELDS	TYPE	COMMENTS
ID	A(8)*	Patient's ID
_Date	D *	Date of blood collection
Kod_Input	A(3)	Code of the person having entered the Form
Kod_Zap	A(3)	Code of the person having completed the Form
Ms_Obsled	S	Place of examination
Kod_VrachEndoc	A(3)	Code of the endocrinologist
Kod_VrachUzi	A(3)	USI physician's code

DifZobYesNo	S	Diffuse goiter: 1 – present; 2 – absent;
DifZobDegree	S	Diffuse goiter - degree
UzZobYesNo	S	Nodular goiter: 1 – present; 2 – absent;
UzZob_A	S	Узловой зоб: 1 – single; 2 – multiple; 3 – mixed;
UzZobKolUz	S	Nodular goiter - number of nodules
UzZobDegree	S	Nodular goiter - degree
SizeUz1	S	Nodular goiter: Size of nodule 1: 1 – nodule size < 5mm; 2 – nodule size >= 5mm;
SizeUz2	S	Nodular goiter: Size of nodule 2: 1 – nodule size < 5mm; 2 – nodule size >= 5mm;
SizeUz3	S	Nodular goiter: Size of nodule 3: 1 – nodule size < 5mm; 2 – nodule size >= 5mm;
SizeUz4	S	Nodular goiter: size of nodule 4: 1 – nodule size < 5mm; 2 – nodule size >= 5mm
UzZob_B	S	Nodular goiter: 1 – solid; 2 – calcificate; 3 – combination; 4 – cystic; 5 – non-verified
UzZob_G	S	Malignancy suspected:: 1 – yes; 2 – no
UzZob_Gnotes	M(2)	Malignancy suspected— comments
LimfoYesNo	S	Lymphadenopathy: 1 – present; 2 – absent
LimfoWithWhat	S	Lymphadenopathy: 1 – on the left; 2 – on the right; 3 – on both sides; 4 – in the middle;

		5 – in the middle and on the left; 6 – in the middle and on the right
LimfoInfected	S	Lymphadenopathy - possibly due to a concomitant regional infection: 1 – present; 2 – absent
TireoiditYN	S	Thyroiditis: 1 – present; 2 – absent; 3 – suspected
TireoiditType	S	Thyroiditis - type: 1 – chronic; 2 – subacute; 3 – acute
5InfringementFuncYN	S	Thyroid function disturbance: 1 – present; 2 – absent; 3 – suspected
5InfringementFuncWW	S	Thyroid function disturbance: 1 – hypothyrodism; 2 – hyperthyroidism; 3 – Graves' disease; 4 – congenital defect
6OtherPathologyYN	S	Other thyroid pathology: 1 - present; 2 – absent; 3 – suspected
6OtherPathologyWW	S	Other thyroid pathology: Ectopia Dysplasia
6OtherPathologyNotes	M(2)	Other thyroid pathology - description
7OtherPathologyYN	S	Other pathology of the neck: 1 – present; 2 – absent; 3 – suspected;
7OtherPathologyWW	S	Other pathology of the neck: 1- salivary glands; 2- median cervical hydrocele 3- other (specify)
7OtherPathologyNotes	M(2)	Other pathology of the neck - description
7OtherPathologyNotes2	M(2)	Other pathology of the neck - specification
8InfringementFuncYN	S	Parathyroid gland disorders: 1 – present; 2 – absent; 3 – suspected
8InfringementFuncWW	S	Parathyroid gland disorders: 1 – hypofunction;

		2 – hyperfunction; 3 – adenoma
BiopsiaYN	S	Fine-needle aspiration biopsy in anamnesis; 1 – present; 2 – absent
BiopsiaMonth	S	Fine-needle aspiration biopsy in anamnesis: Month
BiopsiaYear	S	Fine-needle aspiration biopsy in anamnesis: Year
OperationOnSGYesNo	S	Thyroid surgery in anamnesis: 1 – present; 2 – absent
OperationOnSGMonth	S	Thyroid surgery in anamnesis: Month
OperationOnSGYear	S	Thyroid surgery in anamnesis: Year
LastDiagnosisYN	S	Previous diagnosis (thyroid): 1 – present; 2 – absent
LastDiagnosisWW	S	Previous diagnosis (thyroid): 1 - thyroid cancer; 2 - thyroid adenoma; 3 - congenital hypothyroidism; 4 - postoperative hypothyroidism;. 5 - hypothyroidism of autoimmune genesis; 6 - thyrotoxicosis; 7 - nodular goiter; 8 - chronic thyroiditis; 9 - subacute thyroiditis; 10 - acute thyroiditis; 11 – euthyroid diffuse goiter; 12 - diffuse toxic goiter
LastDiagnosisNotes	M(2)	Previous diagnosis (thyroid): Other (specify)
PreliminaryConclusion	M(2)	Preliminary conclusion on thyroid and parathyroid pathology
OtherEnDiagnosisYN	S	Other endocrinological diagnoses: 1 – present; 2 – absent
OtherEnDiagnosisNotes	M(2)	Other endocrinological diagnoses: Comments
RepeatedVisitYN	S	New visit one year after: 1 – yes; 2 – no
Month6	S	6 months after
Month3	S	3 months after
Month1	S	One month after

DirectionInClinic	S	The patient is referred to a clinic: 1 – yes; 2 – no
DirectionOther	S	The patient is referred to another establishment (hospital or polyclinic): 1 – yes; 2 – no
ClinicNamber	S	Polyclinic's / hospital's number
ClinicType	S	Type of polyclinic / hospital: 1- pediatric; 2- for adults
ClinicTelefon	M(2)	Polyclinic's / hospital's phone number
ClinicNP	A(8)	Settlement where is located the polyclinic / hospital
ClinicAdres	M(2)	Polyclinic's / hospital's address

6.22 To develop DB and software for input of Screening Form "Final conclusion on the results of screening"

A database and program - "Final endocrinological conclusion and recommendations" - for data input from paper, have been developed.

Structure of the DB "Final endocrinological conclusion and recommendations" OK_E_ZAK.DB
(* - key fields)

№.	NAME OF FIELDS	TYPE	COMMENTS
1.	ID	A(8)*	Patient's identification number
2	_Data	D *	Date of completing the Form
3.	Kod_Zap	A(3)	Code of the person having completed the Form
4.	Kod_Input	A(3)	Code of the person having entered the Form
5.	Ms_Obsled	S	Place of examination
6.	Kod_VrachEndok	A(3)	Code of the endocrinologist
7.	Kod_VrachUzi	A(3)	USI physician's code
8.	DifZob	A(1)	Diffuse goiter: *1 – Yes;* *2 – No;* *-9 – unfilled field*

9.	DifZobWhitWhat	A(1)	What goiter: *1 – degree 1;* *2 – degree 2;* *-9 – unfilled field*
10.	UzZob	A(1)	Nodular goiter: *-8 – not completed;* *1 – single;* *2 – multiple;* *3 – mixed;* *-9 – unfilled field*
11.	UzZob_A	A(1)	*1 – single;* *2 – multiple;* *3 – mixed*
12.	UzZob_B	A(1)	Type of nodule: *1 – solid;* *2 – combined;* *3 – cystic;* *4 – calcificate;* *-9 – unfilled field*
13.	ChisloUz	S	Number of isolated nodules
14.	StepUzZob	A(1)	Degree (1 or 2)
15.	NewFormations	A(1)	Thyroid neoplasms: *1 – adenoma;* *2 – cystadenoma;* *3 – non-verified;* *4 – papillary carcinoma;* *5 – follicular carcinoma;* *6 – anaplastic cancer;* *7 – medullary carcinoma;* *8 – other*
16.	NewFormationsNotes	M(1)	Additional information to item No 8 in "Thyroid neoplasms"
17.	DataDiagnosis	D	Date of diagnosis
18.	OtherPatology	A(1)	Non-tumoral pathology: *1 – colloid goiter*
19.	Tireoidit	A(1)	Thyroiditis: *1 – yes;* *2 – no;* *-9 – unfilled field*
20.	TireoiditWhitWhat	A(1)	What kind of thyroiditis: *1 – acute;* *2 – subacute;* *3 – chronic lymphocytic (Hashimoto)* *-9 – unfilled field*
21.	Function_	A(1)	Function: *1 – hypothyroidism;* *2 – hyperthyroidism;*

			3 – euthyroidism; *-9 – unfilled field*
22	Form_	A(1)	Form: *1 – hypertrophic;* *2 – atrophic;* *3 – pseudo-nodular;* *-9 – unfilled field.*
23	Gipotiroz	A(1)	Hypothyroidism: *1 – Yes;* *2 – No;* *-9 – unfilled field*
24	GipotirozWhitWhat	A(1)	What kind of hypothyroidism: *1 – acquired;* *2 – congenital;* *3 – latent;* *4 – obvious (clinical);* *-9 – unfilled field.*
25	Gipertiroz	A(1)	Hyperthyroidism: *1 – Yes;* *2 – No;* *-9 – unfilled field*
26	GipertirozWhitWhat	A(1)	What kind of hyperthyroidism: *1 – latent;* *2 – obvious;* *-9 – unfilled field.*
27.	ParaSG	A(1)	Parathyroid glands: *1 – yes;* *2 – no;* *-9 – unfilled field*
28	ParaSGWhitWhat1	A(1)	What disorders of parathyroids: *1 - hypoparathyroidism;* *2 – postoperative;* *3 – spontaneous;* *-9 – unfilled field*
29	ParaSGWhitWhat2	A(1)	What disorders of parathyroids: *1 – hyperparathyroidism;* *2 – hyperplasia;* *3 – adenoma;* *-9 – unfilled field.*
30	SizeUz1	A(1)	Size of nodule 1
31.	SizeUz2	A(1)	Size of nodule 2
32	SizeUz3	A(1)	Size of nodule 3
33	SizeUz4	A(1)	Size of nodule 4
34.	OtherDiagnosis	A(1)	Other endocrinological diagnoses
35	OtherDiagnosisNotes	M(2)	Comments
36	ZacluchenieNotes	M(2)	Conclusion

37.	KodesMBK1	A(5)	ICD-9 codes
38.	KodesMBK2	A(5)	ICD-9 codes
39.	KodesMBK3	A(5)	ICD-9 codes
40.	KodesMBK4	A(5)	ICD-9 codes
41.	KodesMBK5	A(5)	ICD-9 codes
42.	KodesMBK6	A(5)	ICD-9 codes
43.	KodesMBK7	A(5)	ICD-9 codes
44.	KodesMBK8	A(5)	ICD-9 codes
45.	KodesMBK9	A(5)	ICD-9 codes
46.	RepeatVizit	A(1)	New visit
47.	WhenVizit	S	When
48.	DirectionClinic	A(1)	Referred to a clinic
49.	OtherDirection	A(1)	Referred to other establishments
50.	NamberClinic	S	Clinic's number
51.	WhatClinic	A(1)	Pediatric clinic or clinic for adults
52.	NpClinic	A(8)	Polyclinic's (hospital's) number
53.	AdressClinic	M(2)	Polyclinic's (hospital's) address
54.	TelephoneClinic	A(7)	Phone number
55.	Medicament	A(1)	Medicaments
56.	LeftTiroksin	A(1)	Levothyroxine
57.	LeftTiroksinDoza	S	Dose
58.	LeftTiroksinNotes	M(2)	Comments
59.	Tirostatic	A(1)	Thyrostatic drugs
60.	TirostaticDoza	S	Dose
61.	TirostaticNotes	M(2)	Comments
62.	OtherPreparations	A(1)	Other drugs
63.	OtherPreparationsDoza	S	Dose
64.	OtherPreparationsNotes	M(2)	Comments

6.23 To develop DB and software for input of "Palpatory Form".

A database and program, "Thyroid palpation Form", for data input from paper, have been developed.

Structure of the DB " Thyroid palpation Form" Palpasia.DB
(* - key fields)

NAME OF FIELDS	TYPE	COMMENTS
ID	A(8)	Patient's ID
_Date	D	Date of completing the Form
Kod_input	A(8)	Code of the person having filled in the Form
Kod_Zap	A(8)	Code of the person having entered the Form
Vrach	S	Physician: 1 - Endocrinologist; 2 - USI physician
Vrach_Kod	A(8)	Physician's code
Voice	S	Voice: 1 – normal; 2 – hoarse
HeviBreath	S	Difficult breathing: 1- yes; 2- no
Stridor	S	Stridor: 1 - yes; 2 - no
HeviGlot	S	Difficult swallowing: 1 - yes; 2 - no
RejectionTrah	S	Deviation of trachea: 1 – no; 2 – to the right; 3 – to the left
InflammationNeck	S	Neck swelling: 1 – no; 2 – local; 3 - general
SG_Size	S	Thyroid size: 1 - Degree 0; 2 - Degree 1; 3 - Degree 2
SG_Forma	S	Shape: 1- symmetrical; 2- asymmetrical
SG_Sensitivity	S	Sensitivity: 1 – yes; 2 – no
SG_Surface	S	Gland surface:

		1 – smooth; 2 – lobate; 3 – presence of a nodule; 4 – multinodular
SG_LConsistence	S	Thyroid tissue consistence (left lobe): 1 – soft, elastic; 2 – cystic; 3 – moderately dense; 4 – dense
SG_RConsistence	S	Thyroid tissue consistence (right lobe): 1 – soft, elastic; 2 – cystic; 3 – moderately dense; 4 – dense
NumberOfNodes	S	Number of nodules revealed
LocCode1	A(2)	Localization code of nodule 1
LocCode2	A(2)	Localization code of nodule 2
LocCode3	A(2)	Localization code of nodule 3
LocCode4	A(2)	Localization code of nodule 4
MaxSize1	S	Maximum size (mm) of nodule 1
MaxSize2	S	Maximum size (mm) of nodule 2
MaxSize3	S	Maximum size (mm) of nodule 3
MaxSize4	S	Maximum size (mm) of nodule 4
Consist1	S	Consistence of nodule 1: 1 – elastic; 2 – dense; 3 – petrous
Consist2	S	Consistence of nodule 2: 1 – elastic; 2 – dense; 3 – petrous
Consist3	S	Consistence of nodule 3: 1 – elastic; 2 – dense; 3 – petrous
Consist4	S	Consistence of nodule 4: 1 – elastic; 2 – dense; 3 – petrous
Fixation1	S	Fixation of nodule 1 (1- absent, 2-present)
Fixation2	S	Fixation of nodule 2 (1- absent, 2-present)
Fixation3	S	Fixation of nodule 3 (1- absent, 2-present)
Fixation4	S	Fixation of nodule 4 (1- absent, 2-present)
LymphNodes	S	Lymph nodes: 1-not enlarged; 2-enlarged; 3-conglomerate
NumberLNodes	S	Number of enlarged lymph nodes
LocCodeLymph1	A(4)	Localization code of lymph node 1
LocCodeLymph2	A(4)	Localization code of lymph node 2
LocCodeLymph3	A(4)	Localization code of lymph node 3

LocCodeLymph4	A(4)	Localization code of lymph node 4
MaxSizeLymph1	S	Maximum size (mm) of lymph node 1
MaxSizeLymph2	S	Maximum size (mm) of lymph node 2
MaxSizeLymph3	S	Maximum size (mm) of lymph node 3
MaxSizeLymph4	S	Maximum size (mm) of lymph node 4
ConsistLymph1	S	Consistence of lymph node 1: 1 – soft; 2 – dense
ConsistLymph2	S	Consistence of lymph node 2: 1 – soft; 2 – dense
ConsistLymph3	S	Consistence of lymph node 3: 1 – soft; 2 – dense
ConsistLymph4	S	Consistence of lymph node 4: 1– soft; 2 – dense
FixationLymph1	S	Fixation of lymph node 1 (1- absent; 2-present)
FixationLymph2	S	Fixation of lymph node 2 (1- absent; 2-present)
FixationLymph3	S	Fixation of lymph node 3 (1- absent; 2-present)
FixationLymph4	S	Fixation of lymph node 4 (1- absent; 2-present)

6.24 Input of data on screening results from paper into Project DB.

- Input of journals for registration of examination (Patients examined)
- Input of journals of magneto-optical disks
- Input of data on the dynamics of patients' invitation to examination (results of contact, cause of refusal)
- Input of data from "Locator Form" and "Primary registration Form".

	Forms entered into DB	% out of 3355 patients examined
Locator	3133	93
Primary Registration.	1357	40

After input of 3133 "Locator Forms", the following number of changes have been introduced into passport section of cohort DB :

Parameter	N	% (out of 3133 "Locator Forms" entered)
Surname verified (changed)	515	16
First name verified	207	7

Patronymic verified	635	20
Date of birth verified	1696	54
Exact mail address	1844	58

Also, information has been obtained from entered "Locator Forms", that 210 (7%) cohort members (out of 3133 processed Forms) intend to change their place of residence. 340 (11%) cohort members (out of 3133 processed Forms) have changed their surname.

A general control of the quality of data input from "Locator Forms" has been performed.

8 incorrectly entered dates of examination have been found in Locator Form DB. All 8 incorrect dates represent mechanical mistakes of input, made by the operators. In all 8 cases an incorrect year of examination (1998 instead of correct 1999) has been introduced. All the errors have been eliminated.

6.25 To develop DB and software for input of "Medical Anamnesis Form".

A database and program - "Data on individual medical questioning (medical anamnesis)", have been developed for data input from paper.

Structure of the DB "Data on individual medical questioning (medical anamnesis)" ANAMNEZ.DB

№	NAME OF FIELDS	TYPE	COMMENTS
1.	ID	A(8)	Patient's ID
2.	_Date	D	Date of completing the Form
3.	Kod_Zap	A(8)	Code of the person having filled in the Form
4.	Kod_Input	A(8)	Code of the person having entered the Form

5.	HealthNew	S	Your current health status: 1 - excellent; 2 - very good; 3 – good; 4 – satisfactory; 0 – bad
6.	Health1986	S	Your health status as compared to your status 1986: 1 - much better; 2 - somewhat better; 3 - somewhat worse; 4 - much worse; 5 - practically unchanged
7.	LeikemiaYN	S	Leukemia: 1- yes; 2- no; 3- I don't know
8.	LeikemiaDate	D	Leukemia: date of diagnosis (leukemia)
9.	LeikemiaNotes	M	Leukemia: comments
10.	OtherTumourYN	S	Some types of tumors ? 1- yes; 2- no; 3- I don't know
11.	OtherTumourDate	D	Some types of tumors ? Date of diagnosis
12.	OtherTumourNotes	M	Some types of tumors ? Specify
13.	KataraktaYN	S	Cataract: 1- yes; 2- no; 3- I don't know
14.	KataraktaDate	D	Cataract: date of diagnosis
15.	KataraktaNotes	M	Cataract: specify
16.	DiseaseYN	S	Diseases: 1- yes; 2- no; 3- I don't know
17.	DiseaseDate	D	Diseases: date of diagnosis
18.	DiseaseNotes	M	Diseases: specify
19.	OtherDiseaseYN	S	Some other chronic diseases and operations: 1- yes; 2- no; 3- I don't know
20.	OtherDiseaseDate	D	Some other diseases and operations: date of diagnosis

21.	OtherDiseaseNotes	M	Some other chronic diseases and operatior specify
22.	Fam1DiseaseSGYN	S	Were there or are there thyroid diseases in so members of your family ? 1- yes; 2- no; 3- I don't know
23.	Fam1DiseaseSGNotes	M	Were there or are there thyroid diseases in son members of your family ? If so, indicate the ty of disease.
24.	Fam2DiseaseSGYN	S	Maternal grandfather or grandmother: 1- yes; 2- no; 3- I don't know
25.	Fam2DiseaseSGNotes	M	Maternal grandfather or grandmother: if so, indicate the type of disease
26.	Fdam3DiseaseSGYN	S	The father: 1- yes; 2- no; 3- I don't know
27.	Fam3DiseaseSGNotes	M	The father: if so, indicate the type of disease
28.	Fam4DiseaseSGYN	S	The mother: 1- yes; 2- no; 3- I don't know
29.	Fam4DiseaseSGNotes	M	The mother: if so, indicate the type of disease
30.	Fam5DiseaseSGYN	S	Sisters, brothers: 1- yes; 2- no; 3- I don't know
31.	Fam5DiseaseSGNotes	M	Sisters, brothers: if so, indicate the type disease
32.	FatherYN	S	The father: 1- alive; 2- deceased
33.	FatherYear	S	The father died at the age ___
34.	FatherNotes	M	The father: the cause of dead was: (indicate th disease, trauma, etc.)
35.	MatherYN	S	The mother: 1- alive; 2- deceased
36.	MatherYear	S	The mother died at the age ___
37.	MatherNotes	M	The mother: the cause of dead was: (indicate th disease, trauma, etc.)
38.	Brother_SisterLive	S	Brothers and sisters: number of brothers an sisters alive

39.	Brother_SisterDied	S	Brothers and sisters: number of dead broth and sisters
40.	Brother_SisterYear	M	Brothers and sisters: died at the age____
41.	Brother_SisterDiedNotes	M	Brothers and sisters: the cause: the cause dead was (indicate the disease, trauma, etc.)
42.	Carried_Out	A(3)	Questioning was performed by: specialist's coc
43.	YN1	S	sensation of pressure in thyroid region (lump)
44.	YN2	S	pressure in cervical region
45.	YN3	S	painfulness at palpation
46.	YN4	S	pain irradiation to the ear
47.	YN5	S	difficult swallowing
48.	YN6	S	hoarseness
49.	YN7	S	paresthesia
50.	YN8	S	choking when eating
51.	YN9	S	pain in bones
52.	YN10	S	arthralgia
53.	YN11	S	myalgia
54.	YN12	S	sweating
55.	YN13	S	irritability
56.	YN14	S	palpitation
57.	YN15	S	sensation of heat in the body
58.	YN16	S	tremor of hands
59.	YN17	S	frequent stools
60.	YN18	S	loss of weight
61.	YN19	S	increase in weight
62.	YN20	S	skin dryness
63.	YN21	S	hair shedding
64.	YN22	S	eyebrow or cilia shedding
65.	YN23	S	flaccidity
66.	YN24	S	fatiguability
67.	YN25	S	changed timbre of the voice
68.	YN26	S	more delayed speech
69.	YN27	S	memory impairment
70.	YN28	S	sensation of cold in hands and feet

71.	YN29	S	lactorrhea
72.	YN30	S	amenorrhea
73.	YN31	S	constipation
74.	YN32	S	unpleasant sensations in eyes
75.	YN33	S	sensation of foreign body, sand
76.	YN34	S	lacrimation
77.	YN35	S	eyelid edema
78.	YN36	S	eyelid chemosis
79.	YN37	S	exophthalmos
80.	YN38	S	sensation of "seeing double" in eyes
81.	YN39	S	myasthenia
82.	Kg1	N	if so, for item 60: how many kg ?
83.	Mon1	S	if so, for item 60: for what period (months) ?
84.	Kg2	N	if so, for item 61: how many kg ?
85.	Mon2	S	if so, for item 61: for what period (months)
86.	LeikemiaNotes2	M	Specify
87.	OtherTumourNotes2	M	Specify
88.	KataraktaNotes2	M	Specify
89.	DiseaseNotes2	M	Specify
90.	OtherDiseaseNotes2	M	Specify

Besides, the following tasks have been carried out:

1) All Project DB have been reduced to third normal form.

Reduction of the model to required level of normal form is a basis for establishment of a relational DB.

The data presented in the form of a bidimensional table, represent the first normal form of relational model of data.

A ratio is assigned in second normal form if it is a ratio in first normal form, and each attribute which is not a primary one in this ratio, completely depends on every possible key of this ratio.

A ratio is assigned in third normal form if it is assigned in second normal form, and each attribute of this ratio which is not a primary one, depends non-transitively on every possible key of this ratio.

The transitive relationship reveals duplication in one ratio. If A, B and C are three attributes of the ratio, and C depends on B, and B on A, it is said: C depends transitively on A.

In the process of normalization, the elements of data are grouped in tables representing objects and their interrelationship. The theory of normalization is founded on the fact that a certain set of tables has better features at inclusion, modification and elimination of data, as compared to all other sets of tables, using which the same data may be represented. Introduction of ratio normalization when developing an information model ensures a minimum volume of physical DB (i.e. recorded on some carrier), and its maximum speed of response, what directly influences the quality of functioning of the information system.

2) Guarantee of integrity of database of a complex

The problem of integrity lies in ensuring the correctness of data in each table at any moment, and represents a matter of paramount importance when designing a logical structure of database.

Data integrity in a system is ensured by a set of restrictions. They represent assertions as to legitimate values of individual information unities and links between these. Restrictions of integrity reflect the features of an object field.

These restrictions may belong to different information objects: attributes, corteges, ratios, links between ratios.

The following types of restrictions are used for attributes in a system:

⇒ Type and format of field. Each field in every database of a complex has a certain type (symbol type, numeral, logical or data type), and a format.

⇒ Assignment of a range of values: It is used only for numeral fields. Only closed ranges are used in a system (the values of both limits are fixed).

⇒ Sign of non-empty field: Inadmissibility of an empty field allows to avoid appearance in a database of “no man's” records in which some key fields are missed.

⇒ Assignment of a domaine: The field may have values out of an assigned number of values. This allows to avoid an excessive variety of values if it may be restricted.

⇒ Algorithmic determination of a domaine. DataBase Management System Borland Delphi 3 supports the type of field “Data”, and when entering values it ensures an automatic check for admissibility of the value entered.

The following types of restrictions are used for the corteges:

Requirement for a unique character of each line of a table: All the ratios in a system are in third normal form, and they may not include identical corteges.

3) All the necessary has been prepared for searching and contacting cohort members.

- Lists of cohort members having moved within one oblast, have been printed in order to specify their address in passport offices.
- Lists have been printed for search of cohort members who were not found, for different raions, in order to search these in raion and oblast passport offices.
- Lists of cohort members have been printed, who have an incomplete address in order to specify their address in raion and oblast passport offices (Kyiv, Zhytomyr, and Chernihiv oblasts).
- Lists of cohort members who have been found but not examined, have been printed for different raions (Narodychi, Ovruch, Ripky, Chernihiv, Kozelets) for a new invitation (dynamics of patients' invitation)
- Post-cards of consent to participate in the Project have been prepared and printed for different raions.

Raion	Number	Comments
City Chernihiv	411	Invitation to examination
Ripky	743	Invitation to examination
Narodychi	571	New invitation to examination for cohort members who have been found but not examined
Ovruch	1290	New invitation to examination for cohort members who have been found but not examined
Ivankiv, Gornostaipil	393 13	New invitation to examination for cohort members who have been found but not examined

DDC enters data on the dynamics of invitation.

4) Elaboration of a complex of programs for input of all Forms has been completed

Development of a complex of programs for input of all Forms of active screening (Locator, Primary Registration, USI, Palpation, Blood Collection, Laboratory Blood Test, Preliminary and Final Conclusion of Screening) has been completed.

The program is being adjusted. Pilot (control) input of data from all Screening Forms into database has been started.

Corrections have been introduced in all the programs of Screening Form input and al Project databases, which provide for storage of codes of data registering incompleteness oı incorrectness of entered information. For example, if only two variants of answers - YES oı NOT - are available on paper, in the database three coded variants of answer may be stored: 1 - YES; 2 - NO; and -9 - unfilled field in the database.

On the basis of this coding, a software complex will be established in order to ensure quality control of entered information, as well as a system of journalling of operator errors of data input and mistakes of Form completion by physicians and interviewers.

7. Pathology support for diagnosis of various forms of thyroid pathology.

7.1. To continue collecting and pathological examination of morphologic material from all patients born in 1968 and later from cohort oblasts and having been operated at the Institute of Endocrinology for different thyroid diagnoses. Pathomorphologic analysis of collected material.

Collection of biopsy material has been continued in the form of paraffin blocks and histological preparations from patients born in 1968 and later, who reside in Kyiv oblast (including city of Kyiv), Chernihiv, Zhytomyr oblasts and have been operated during the reported period for different forms of thyroid pathology at the Clinic of the Institute of Endocrinology or in other clinics of Ukraine. In the latter case, paraffin blocks have been provided to the Laboratory for a consultative conclusion. For the period March - May 1999, material from **41 cases of surgical thyroid pathology** has been collected. Among them, **5 cases represented relapses of papillary carcinoma metastases in lymph nodes;** primary tumors have been removed: one in 1992, one in 1995, two in 1998 and one in January 1999. **20 cases were newly diagnosed thyroid carcinomas** (6 cases from Kyiv oblast, 5 from Chernihiv oblast, 4 from Zhytomyr oblast, and 5 from the city of Kyiv); **2 cases of follicular adenoma** (one case from Zhytomyr oblast, and one from the city of Kyiv); **10 cases of nodular goiter** (3 cases from Chernihiv oblast, one from Zhytomyr oblast, and 6 from the city of Kyiv); **2 cases of multinodular goiter** (one case from Kyiv oblast and one from Chernihiv oblast); and **2 cases of diffuse toxic goiter** (one case from Kyiv oblast and one from Chernihiv oblast).

For diagnostic purpose, 280 blocks have been embedded in paraffin, and more than 560 histological preparations have been studied at light microscope.

All the 20 primary cases of thyroid cancer studied represented a papillary carcinoma: 5 tumors of this type were removed in children aged 11-14 years (at the time of the accident 4 children were aged from 7 months to 1 year and 10 months, and one child was born after the accident, in 1987); 5 tumors were removed in adolescents aged 15-16; and 10 tumors in young adult patients aged 19 to 30 (at the moment of the accident 9 of them were children aged 6-14 years, and one patient was an adolescent aged 17).

As to their histological structure, papillary carcinomas in 6 cases (30 %) had a typical papillary structure; in 3 cases (15 %) - a dominant follicular structure; and in 7 cases (35 %) a mixed follicular-solid structure with papillary areas, what points out that carcinomas with solid-follicular structure prevailed (70 %). In one patient (a young woman aged 25 from Kyiv oblast) the tumor was only 0.5 cm in diameter, it was localized next to the follicular adenoma, was not clinically identified; therefore, it was verified as a papillary microcarcinoma. Carcinoma metastases in regional lymph nodes have been morphologically established in 6 cases (30 %).

Follicular adenomas had a dominant microfollicular-solid structure.

Nodular solitary goiters were characterized by a heterogeneous morphologic structure, in 5 cases (50 %) cystic transformation was noted. In one case nodular goiter with cystic transformation was established in a girl aged 12 years, i.e. born after the Chornobyl accident, in 1987. This patient lives in Chernihiv oblast.

A multinodular goiter of heterogeneous histological structure has been verified in 2 young adults aged 24-25 years.

A diffuse toxic goiter was present in a girl-adolescent aged 16 and in a young adult woman aged 28 years.

7.2. Preparation of additional histological specimens for the morphologic data bank of the Ukr.-Am. Project (after identification of concrete patients included in the cohort).

A detailed information on the above cases, which included patient's passport data, exact date of birth, place of residence during the accident and to date, has been provided to the Dosimetry Department of the Scientific Center of Radiation Medicine and to DCC in order to identify persons who had direct measurements of thyroid activity and were included in the cohort. It has been established that among the subjects who have been operated within the reported period, **8 patients belonged to the cohort, four of whom have been revealed in the process of screening examinations** in Narodychi raion of Zhytomyr oblast (2), Chernihiv (1) and Kozelets (1) raions of Chernihiv oblast (for more details see 7.3). In the rest of patients **a papillary carcinoma has been verified in 3 cases**, one of which belonged to the "main" 20000-cohort (group "C"), one to the 75000-cohort (Group "A"), and one belonged to the general 100000-cohort (group "A"). One patient (female) with nodular goiter belonged to the main 20000-cohort (dose group "C"). Additional histological preparations have been prepared from the paraffin blocks of the tumors removed, extratumoral tissue and metastatically affected lymph nodes of the above cases, for the morphologic data bank of the Ukr.-Am. Project.

As a whole, in the morphologic data bank of the Ukr.-Am. Project, among the cases identified after surgery in the cohort (persons who have been identified by screening examinations are not taken into account !), 26 cases of papillary thyroid carcinoma and 11 cases of benign pathology (3 follicular adenomas, 4 nodular solitary goiters, 3 multinodular goiters, and one diffuse toxic goiter) have been collected within three years.

On the basis of an analysis of data from clinical-morphologic Registry and specimens received from other clinics, among the subjects identified in the cohort, 4 more cases of papillary thyroid carcinoma (3 cases from the 75000-cohort and one from the general 100000-cohort) have been additionally established; but in these cases operations have been performed in other clinics, and so far no paraffin blocks or histological preparations are available.

Thus, within 3 years of work the so-called "passive screening" allowed to reveal among the subjects identified in the cohort 30 cases of papillary thyroid carcinoma and 11 cases of benign pathology.

Together with DCC, an additional analysis of the above cases has been made as regards patients' distribution in the 20000-, 75000-, and general 100000-cohort.

So, among 30 cases of thyroid carcinoma, 12 (40 %) belong to the main 20000-cohort (all cases in dose group "C"), 11 cases (37 %) to the 75000-cohort (3 cases in group "B" and 8 cases in group "A"), and 7 cases (23 %) belong to the general 100000-cohort (one case in group "C", one in group "B", and 5 cases in group "A").

Among 11 cases of benign thyroid pathology, 2 cases (18 %) belong to the main 20000-cohort (group "C"), 5 cases (45 %) to the 75000-cohort (one case in group "B" and 4 in group "A"), and 4 cases (40 %) belong to the general 100000-cohort (all cases in group "B").

7.3. To ensure intraoperational diagnosis, histological processing and pathomorphologic analysis of specimens received from patients selected for surgery after screening. Preparation of additional histological specimens for the morphologic data bank of the Ukr.-Am. Project.

Screening examinations performed to date allowed to identify 4 patients for surgery, who have been operated on. Among them, 3 girls-adolescents aged 15, 15 and 16 years from Kozelets raion of Chernihiv oblast and Narodychi raion of Zhytomyr oblast, and a young adult woman aged 25 from Chernihiv raion of Chernihiv oblast (all belong to dose group "C"). The above adolescents were, at the time of the accident, aged up to 4 years, and the young adult woman was aged 12.

In 3 of four cases in question, a papillary carcinoma has been verified. Two adolescents had a non-encapsulated tumor measuring 1.0 x 0.8 x 1.0 (cm) and 1.0 x 1.1 x 0.9 (cm) with dominant papillary and follicular structure without signs of extrathyroid growth and metastatic lesion of lymph nodes. In a young woman the tumor represented a conglomerate of nodules of a diameter of 1.5, 2.0 and 2.2 cm. Microscopic study showed a dominant solid variant of papillary carcinoma with marked signs of glandular spreading, multifocal and extrathyroid growth, lymphatic invasion, presence of metastases in lymph nodes.

In a girl-adolescent a follicular adenoma of dominant micronormofollicular structure of a diameter of 1.5 cm has been verified.

In all cases, additional histological preparations have been prepared from the paraffin blocks of the tumors removed, extratumoral tissue and metastatically affected lymph nodes, for the morphologic data bank of the Ukr.-Am. Project.

Thus, to date screening examinations allowed to establish 6 papillary carcinomas and one follicular adenoma.

Taking into consideration that mobile teams have examined 3000 persons, the rate of identification of thyroid cancer is very high. It should be also stressed that 4 out of 6 carcinomas (67%) represent a solid variant of papillary carcinoma which, according to our preliminary estimates, has marked signs of aggressive behavior, what is confirmed by the presence of metastases in lymph nodes in 3 out of 4 cases in question.

7.4 To fill in the Pathology Forms for the patients with revealed cases of thyroid pathology, included in the cohort under study. To set these data into the computer and provide them to DCC (after receipt of computers).

The Pathology Forms for the all the cases identified in the cohort have been filled in on paper. The Laboratory of Pathology has been provided with a computer which was formerly (before installation of new modem equipment) used in DCC. After DCC staff have developed appropriate programs, the Forms will be completed on computer; but, so far, data transfer to DCC is impossible, because of problems with network communication and incompatibility of diskette size between the computer provided to the Laboratory and new computers installed in DCC.

LIST

of reagents and supplies received by the Institute of Endocrinology and Metabolism of the Academy of Medical Sciences of Ukraine from the U.S.A. in the framework of the joint Ukr.-Am. Project in March - May 1999

№	Quantity	Description	Location	Person Responsible
	100 Best	LUMItest Tg 100 Best.	Lab.radiology	O.V.Epshtein
	100 Best	LUMItest a-TPO 100 B.	Lab.radiology	O.V.Epshtein
	1 Fl	LUMI a-TPO Puf. C	Lab.radiology	O.V.Epshtein
	1Fl	LUMI a-TPO Puf. D	Lab.radiology	O.V.Epshtein
	1000 Best	LUMI Basiskit 1000 Best.	Lab.radiology	O.V.Epshtein
	400 ml	LUMI Waschl. 4000 Best.	Lab.radiology	O.V.Epshtein
	100 Best	LUMItest TSH 100 B.	Lab.radiology	O.V.Epshtein
	1000	Vacutainer SST TUBES 9,5 m	Lab.radiology	O.V.Epshtein
	1000	Vacutainer Needles	Lab.radiology	O.V.Epshtein

DOSIMETRY SUPPORT OF THE «UKRAINIAN-AMERICAN SCIENTIFIC PROJECT ON THE STUDY OF CANCER AND OTHER THYROID DISEASES IN UKRAINE AS A CONSEQUENCE OF THE CHORNOBYL ACCIDENT»

(Fourth quarter of report, Parts 8.7, 8.22, 8.15, 8.23, 8.24)

1998-1999

CONTENTS

8.7. TO CONTINUE THE SUPPORT OF THE QUESTIONNAIRE DB. ESTABLISH, AUGMENT, AND MAINTAIN DATABASE OF PERSONAL QUESTIONNAIRE DATA FOR COHORT MEMBERS. DATA LINKAGE

In the fourth quarter of investigations 1998-1999 (period from March to May 1999) collection of dosimetry questionnaires was continued within mobile teams and during examinations of cohort members at the Institute of Endocrinology and Metabolism.

Table 8.7.1 gives the distribution of questionnaires collected in the last quarter according to the age of cohort members at the accident and raions of residence in the period of the accident.

Table 8.7.1 Distribution of personal questionnaires collected in the 4th quarter, according to age groups and raions

Raion	Age, years				Total
	0-4	5-9	10-14	15-18	
Ovruch	0	1	0	0	1
Prypyat	0	0	1	0	1
Kozelets	184	70	59	15	328
Repky	217	101	103	16	437
Chernihiv raion	160	88	72	26	346
City Chernihiv	83	55	32	3	173
Total	644	315	267	60	1286

Table 8.7.2 gives the distribution of questionnaires collected according to the raions of residence in the iodine period of the accident and dose groups.

Table 8.7.1 Distribution of personal questionnaires collected in the 4th quarter, according to dose groups and raions

Raion	Dose groups			Total
	A	B	C	
Ovruch	0	1	0	1
Prypyat	1	0	0	1
Kozelets	94	69	165	328
Repky	162	144	131	437
Chernihiv raion	109	86	151	346
City Chernihiv	80	53	40	173
Total	446	353	487	1286

All collected questionnaires have been entered into a computer database, coding has been made of information on settlements of residence and settlements of evacuation or relocation in the iodine stage of the accident. These codes serve as a key for linkage with information on coordinates of settlements. Thus, questionnaire information is incorporated into the system of geocoded databases.

The procedure of testing correctness of finding a cohort member has been included in current work. Testing was being performed during questioning using a portable computer with information from dosimetry DB. The cases of noncoincidence of personal identification information in dosimetry DB and in lists of 20,000-cohort members found have been identified using methods of computer linkage of databases.

After analysis of questionnaires collected for the 4th quarter 1998-1999, 4 cases of incorrect incorporation into the cohort have been revealed, and two of these persons are to be included in the cohort but under another ID (and this means - with another result of measurement of thyroid activity). Table8.7.3 gives a list of persons with an ID having been conferred by mistake.

Table 8.7.3. – List of persons with incorrect ID from questionnaires which have been collected in the 4th quarter.

Surname in 1986	Surname in 1998	First name	Patronymic	ID	ID-correct	Member of the cohort
				02923319	11909323	No
-				10178017	05971527	Yes
-				05230616	10178017	Yes
				02095117	08788031	No

8.22. PRELIMINARY ANALYSIS OF QUESTIONNAIRE INFORMATION

Aim of the work: to carry out a preliminary descriptive analysis of all questionnaire information collected for all the period of work.

For the period in question, 3339 potential members of the 20,000-cohort have been questioned. After verification of information in the process of questioning, it has been found out that 7 persons have to be excluded because their age at the moment of the accident did not meet the requirements for incorporation into the cohort. For 69 more questionnaires the information collected is being verified, one corresponds with these cohort members and their questionnaires have also been excluded in the present analysis. Thus, a preliminary analysis has been performed on 3263 personal dosimetry questionnaires of 20,000-cohort members.

Table 8.22.1 gives the distribution of collected questionnaires according to the age of cohort members at the time of the accident and raions of residence during the accident.

Table 8.22.1 Distribution of questionnaires according to age groups and raions

Raion	Age, years				Total
	0-4	5-9	10-14	15-18	
Narodychi	232	120	119	36	507
Ovruch	392	154	159	26	731
Ivankiv	45	35	44	10	134
Polisya	1	0	0	0	1
Chornobyl	29	17	15	3	64
Prypyat	108	112	51	10	281
Kozelets	361	113	90	24	588
Repky	217	101	103	16	437
Chernihiv raion	160	88	73	26	347
City Chernihiv	83	55	32	3	173
Total	1628	795	686	154	3263

Table 8.22.2 gives the distribution of collected questionnaires according to raions of residence in iodine stage of the accident and dose groups.

Questionnaire information was analyzed concerning milk, leafy vegetable daily consumption rates and taking stable iodine preparations in different periods of iodine phase of the accident.

Table 8.22.2. Distribution of questionnaires according to dose groups and raions

Raion	Dose groups			Total
	A	B	C	
Narodychi	21	106	380	507
Ovruch	169	276	286	731
Ivankiv	50	32	52	134
Polisya	0	0	1	1
Chornobyl	7	15	42	64
Town Prypyat	38	51	192	281
Kozelets	191	158	239	588
Repky	162	144	131	437
Chernihiv raion	109	87	151	347
City Chernihiv	80	53	40	173
Total	827	922	1514	3263

Table 8.22.3 gives data on distribution of respondents who did not consume milk in different raions and periods of iodine phase of the accident. In a minor part of the questionnaires (from 0 to 12%) there was no information on the milk consumption rates since the respondents were not able to answer this question. In the persons having answered this question, daily milk consumption varied from one period to another, in certain periods (late May) the number of persons who provisionally did not consume milk, reached 75% (Ivankiv raion)

Table 8.22.3. Number of persons who did not consume milk in different periods

Raion	Number of question-naires	% of questionnai-res in which information on milk con-sumption is missed	% of persons who did not consume milk in the periods:			
			26-30 April	1-10 May	11-21 May	22-31 May
Narodychi	507	6	16	17	18	20
Ovruch	731	6	11	12	13	12
Ivankiv	134	1	19	22	45	75
Polisya	1	0	0	0	0	0
Chornobyl	64	0	23	28	34	39
Town Prypyat	281	1	30	31	40	58
Kozelets	588	9	7	8	10	12
Repky	437	2	4	4	5	5
Chernihiv raion	347	4	10	10	10	10
City Chernihiv	173	12	2	2	2	2

Table 8.22.4 gives data on average daily milk consumption rates (per caput) in different raions and different periods after the accident among those who answered the question on milk consumption. The average milk consumption was not sharply changed at the beginning of May when people learnt the news of the accident; a decrease in milk consumption may be noted only in the last third of May.

Table 8.22.5 presents information on the sources of milk having been consumed. The main source of milk consumed were back-yard cows, consumption of such kinds of milk as goat's milk or powder milk is reported in isolated cases.

Table 8.22.6 gives data on the number of persons who consumed in May 1986 leafy vegetables. The highest percentage of persons who consumed leafy vegetables among the respondents having answered this question and who consumed them at amounts over 10 grams a day, is noted in raions of Chernihiv oblast.

Table 8.22.6. Consumption of leafy vegetables in the period 26.04.86 to 31.05.86 according to the data of interview with cohort members

Raion	Number of respondents	% of questionnaires with missed information on leafy vegetable consumption	% of persons with different level of leafy vegetable consumption		
			did not consume	limited consumption up to 10 g a day	consumption over 10 g a day
Narodychi	507	5.72	22.49	0.59	71.20
Ovruch	731	5.61	26.67	0.56	67.16
Ivankiv	134	2.24	29.85	0.75	67.16
Polisya	1	0.00	0.00	0.00	100.00
Chornobyl	64	1.56	31.25	3.13	64.06
Town Prypyat	281	1.07	46.98	1.06	50.89
Kozelets	588	7.48	21.61	8.84	62.07
Repky	437	2.52	11.90	0.00	85.58
Cherihiv raion	347	1.44	9.51	0.00	89.05
City Chernihiv	173	14.45	8.67	0.58	76.30

Table-8.22.4. Average per caput daily milk consumption rates in April-May 1986 according to the data of cohort members questioning

Raion	Average milk consumption (L/d) and number of questionnaires being analysed for different periods of 1986											
	April 26-30			May 1-10			May 11-21			May 22-31		
	N	*Mean*	σ^2	*N*	*Mean*	σ^2	*N*	*Mean*	σ^2	*N*	*Mean*	σ^2
Narodychi	477	0.41	0.22	474	0.42	0.24	474	0.41	0.24	463	0.36	0.18
Ovruch	686	0.39	0.10	683	0.38	0.11	682	0.38	0.11	681	0.38	0.11
Ivankiv	132	0.48	0.26	132	0.44	0.24	130	0.31	0.21	131	0.13	0.13
Polisya	1	0.50	-	1	0.50	-	1	0.50	-	1	0.50	-
Chornobyl	64	0.42	0.16	64	0.41	0.17	63	0.36	0.17	63	0.34	0.17
Town Prypyat	279	0.31	0.13	279	0.28	0.10	278	0.25	0.13	278	0.16	0.09
Kozelets	535	0.43	0.13	527	0.42	0.13	524	0.41	0.13	522	0.40	0.13
Ripky	429	0.44	0.13	429	0.44	0.13	429	0.43	0.12	429	0.41	0.11
Chernihiv raion	332	0.40	0.16	331	0.40	0.16	331	0.40	0.16	331	0.38	0.15
City Chernihiv	152	0.30	0.03	151	0.30	0.03	151	0.30	0.03	151	0.30	0.04
Total for all raions	3087	0.40	0.23	3071	0.39	0.23	3063	0.38	0.22	3050	0.35	0.15

Table 8.22.5. Sources of consumed milk in April-May 1986 according to the data of cohort member interviewing

Raion	Number of respondents	% of questionnaires without data on milk source	% of questionnaires from persons having not consumed milk[1]	% of questionnaires in persons who consumed milk from different sources[2]				
				back-yard cows' milk	from trading network	goat's milk	breast' milk	powder milk
Narodychi	507	5	16	64	15	0	3	0
Ovruch	731	4	11	73	10	1	6	1
Ivankiv	134	1	17	63	31	2	1	2
Polisya	1	0	0	100	100	0	0	0
Chornobyl	64	0	23	63	14	0	2	2
Town Prypyat	281	0	25	50	27	1	1	1
Kozelets	588	4	8	72	12	2	6	2
Ripky	437	2	4	87	3	1	5	2
Chernihiv raion	347	2	9	84	2	1	3	1
City Chernihiv	173	13	2	29	68	0	2	2

[1] Having not consumed milk in none of the periods of observation.

[2] In case the questionnaire contains two and more sources of milk consumed, each of sources is considered as a separate one.

Table 8.22.7 presents data on consumption of stable iodine preparations by cohort members. It should be noted that the evacuees remember well this information. The highest rate of persons who have been taking stable iodine is noted among the inhabitants of the town of Prypyat and Chornobyl raion (58 and 44%, respectively), where a distribution of iodine preparations had been organized among the population before evacuation. In Ivankiv raion 17% of the persons questioned have been taking stable iodine, what also points out in favour of an organized distribution of this preparation to children. Isolated cases of stable iodine use in raions of Chernihiv oblast and city of Chernihiv are also confirmed by questioning medical staff in Chernihiv oblast: there was no organized distribution of iodine preparations in raions of Chernihiv oblast. Only for the town of Oster information is available that the medical workers of the town delivered iodine preparations to the inhabitants.

Table 8.22.7. Taking stable iodine preparations in April-May 1986 by the interviewed cohort members

Raions	Number of questionnaires	Number of persons who have been taking stable iodine				
		Total	Multiple intake (2 days and more)	With intake in the first 15 days after the accident (before May 10)	With intake after May 10	With missing information on dates of intake
Narodychi	507	34	6	15	11	8
Ovruch	731	20	12	6	7	7
Ivankiv	134	23	17	20	3	0
Polisya	1	0	0	0	0	0
Chornobyl	64	28	16	27	1	0
Town Prypyat	281	159	45	158	1	0
Kozelets	588	12	9	10	0	2
Ripky	437	6	2	2	4	0
Chernihiv raion	347	8	0	0	7	1
City Chernihiv	173	0	0	0	0	0
Total	3263	290	107	238	34	18

8.15. VERIFICATION OF CALIBRATION FACTORS ON THE BASE OF ANALYSIS OF SPATIAL DISTRIBUTION OF AVERAGE AGE- AND LOCATION-DEPENDENT THYROID EXPOSURE DOSES

Verification of calibration coefficients was carried out for thyroid activity measurements in population of Kozelets raion of Chernihiv oblast. To analyze reliability of correction for calibration coefficients, which took place in the 3rd quarter of the 3rd year of research (see Report, December 1998-February 1999), there was utilized thematic mapping approach for average group thyroid exposure doses, estimated under measurements with serial-number-defined device after correction of calibration coefficients. Grouping was conduced by 4 age groups of the population (1-6-year-olds, 7-12-year-olds, 13-18-year-olds and over 18-year-olds as of the moment of the accident) and by Local Councils (village councils and township councils). Local council (LC) is a community of 1 to 10 nearby settlements under common administrative jurisdiction (in central settlement of LC), distance between which does not exceed 12-15 km. The grouping enabled uniting data on nearby-located settlements and on comparable ages. Thus, it allowed comparing results of measurements with different devices, which could not be directly compared in the prior time, when average doses were calculated by uniform age groups (of the same year of birth) and by particular settlements. Besides, the official data (maps) on density of soil contamination with ^{137}Cs were used for analysis.

Average doses were calculated taking into account the log-normal dose distribution, provided more than 11 measurements in the considered age group in a LC, performed by device with specific serial number.

Out of 8 different devices used to measure population of Kozelets raion, 4 were non-spectrometric (SRP-68-01 #906, #935, #957, #1300), whereas the other 4 were different-type spectrometers (GTRM-01c, NC-150, NC-350). All the considered SRP-68-01 had no calibration results. Comparative analysis for these devices was possible only for #1300 (measurements of children from Kozelets raion were performed in Sums'ka oblast) and for #957, which was used for measurements in Chernihiv oblast (see Quarter Report, December 1998 – February 1999). SRP # 1300 did not require correction in case when average Ukrainian calibration coefficient (*CF*) of $4.18*10^{-3}$ μCi h per μR was used for this particular device. Under the results of comparative analysis (see Quarter Report, December 1998 – February 1999), correction of *CF* was carried out for SRP #957. Problem on correction of

CF for SRP #906 и #935 devices remains open, since comparative analysis of these devices against results of measurements with reliable calibration is impossible, given the generalization level used in the method of comparative analysis.

Fig.8.15.1–Fig.8.15.4 present spatial distribution of age average exposure doses in all the *LC* of Kozelets raиon of Chernihiv oblast after correction of *CF*, conducted in the 3rd quarter. On the figures, average doses by *LC* are attached to settlements, which serve as *LC* centers (centers of *LC* are marked with numbers, which are part of the code for Ukraine's settlements, worked out in the laboratory).

The figures show that correction of *CF* was valid for SRP #1300 and #957. Following the correction, average doses for *LC*, calculated under data of measurements with these devices, are practically non-different from doses, calculated under results of spectrometric measurements.

The results in *LC* codified as "03", "23", and "32", where SRP # 906 device can be compared to other devices with a more reliable calibration (with GTRM #32 and SRP #957 in "03" and "23"; and with NC-150 #71077 and SRP #1300 in "32"), evidence that SRP #906 requires correction of *CF* (a 1.5-2 times reduction of *CF*, which is currently equal to $4.18*10^{-3}$ μCi h per μR).

SRP #935 can not be compared to other devices even for the level of generalization by LC and age groups. This was the only device to be used in measurements of population in LC "28", "30" и "36", located close to eastern boundary of Kozelets raion. However, spatial representation allows stating that average doses, estimated under results of measurements with SRP #935, do not correspond with average dose gradient and gradient of soil contamination with ^{137}Cs by all the age groups. For this particular device, results of background gamma-dose rate measurements (200 μR per h for measurements on May 31 - June 1m 1986), provided no spots of soil contamination with ^{137}Cs, are abnormally high. Over the period from May 28 till June 3, levels of background gamma-dose rate exceeding 170 μR per h were registered only in Narodichy and Ovruch raions of Zhitomir oblast, which were subject to higher soil contamination with ^{137}Cs. In Kozelets raion, in areas measured with SPR, background gamma-dose rates did not surpass 125 μR per h. All these prove that *CF* requires correction for SRP#935.

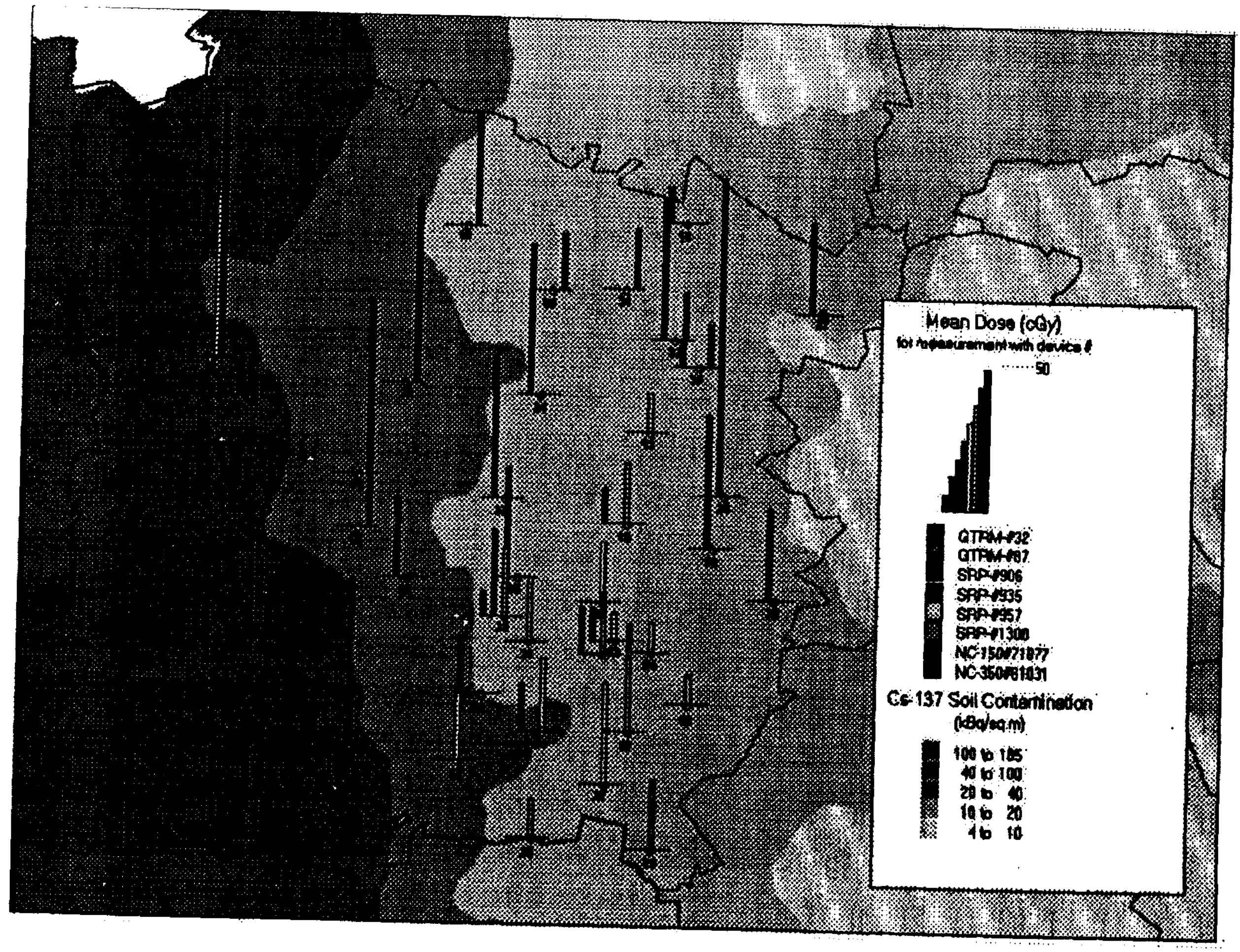

Fig. 8.15.1. Spatial distribution of device-specific mean thyroid doses for Local Council in age group 1-6 years at exposure

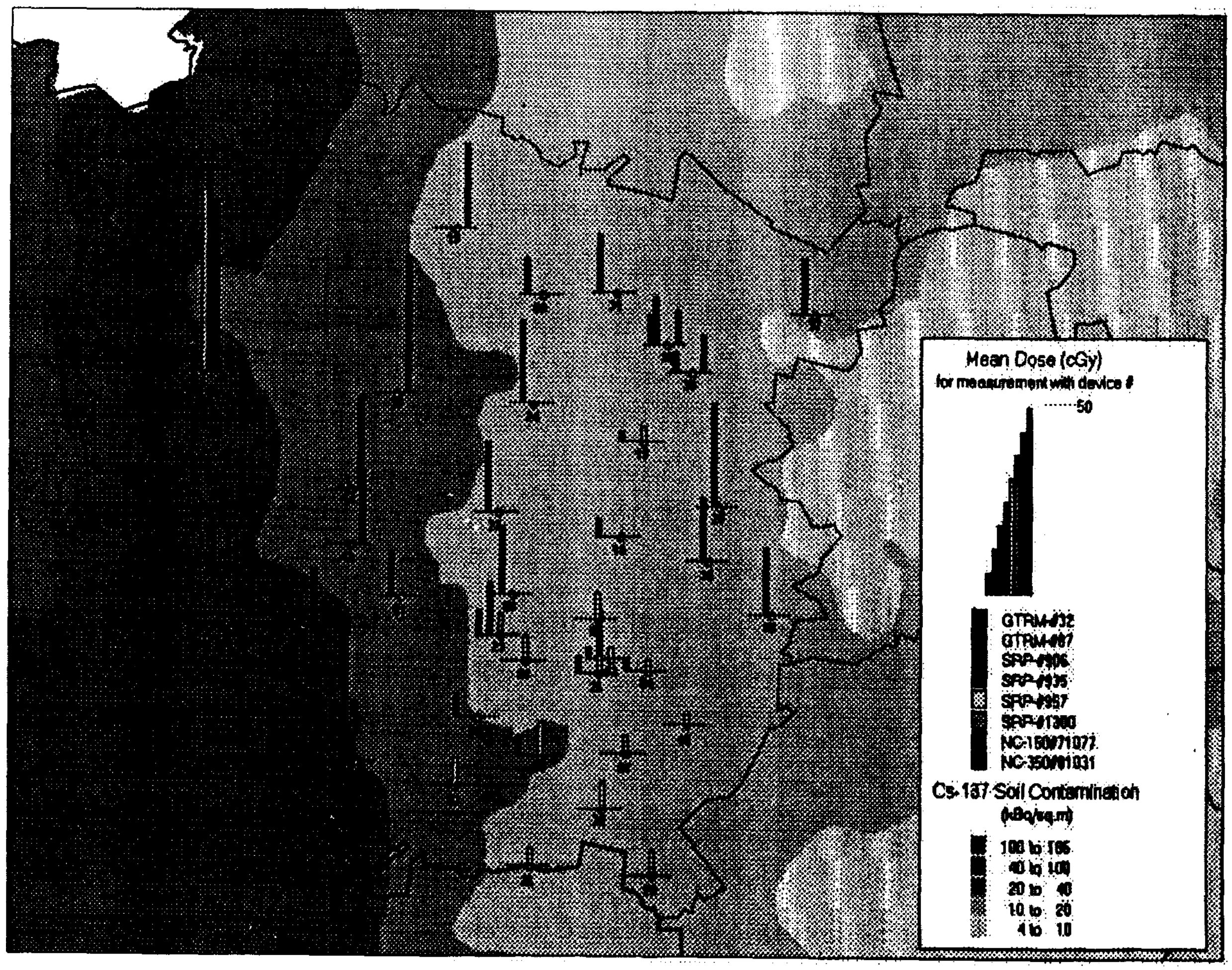

Fig. 8.15.2. Spatial distribution of device-specific mean thyroid doses for Local Council in age group 7-12 years at exposure

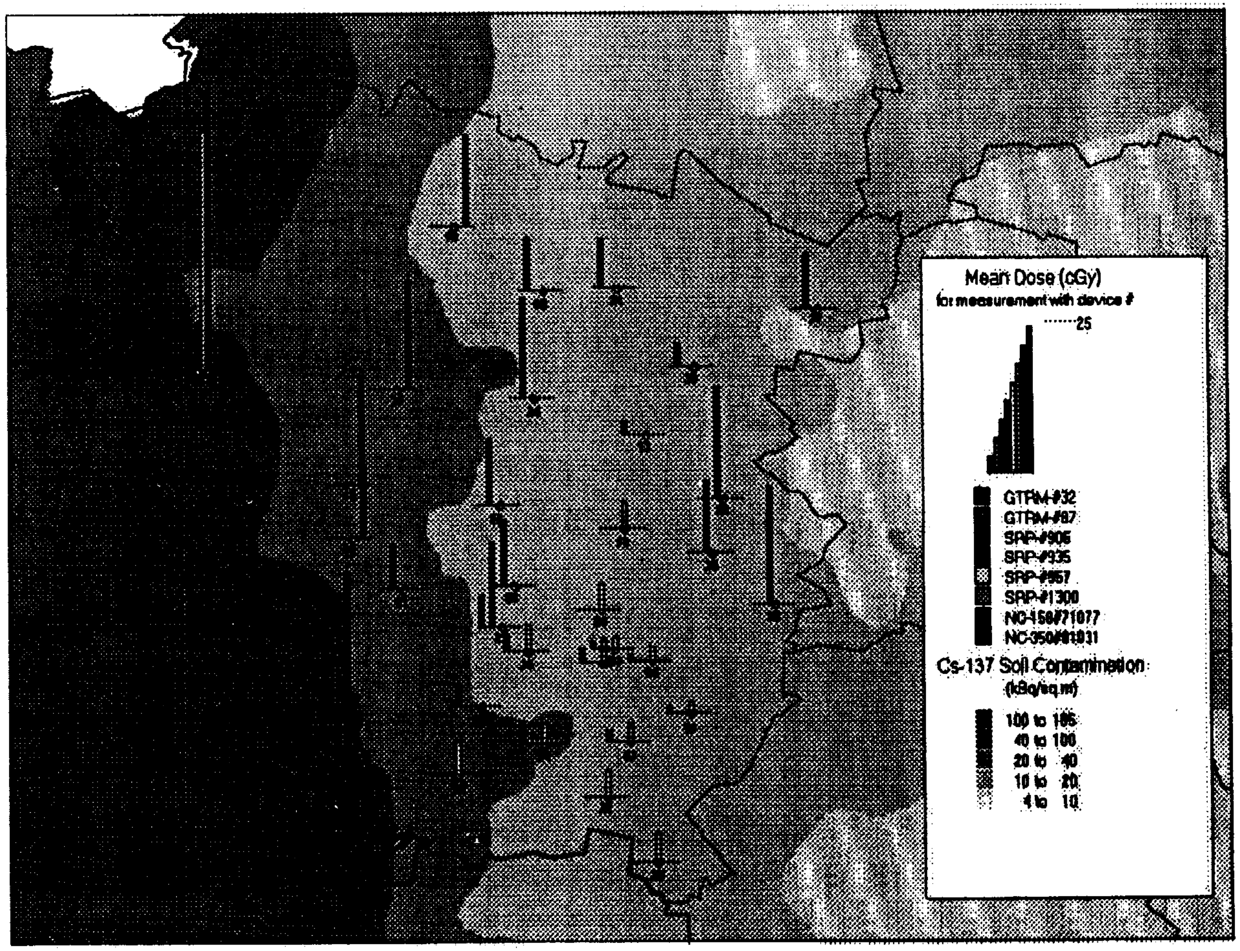

Fig. 8.15.3. Spatial distribution of device-specific mean thyroid doses for Local Council in age group 13-18 years at exposure

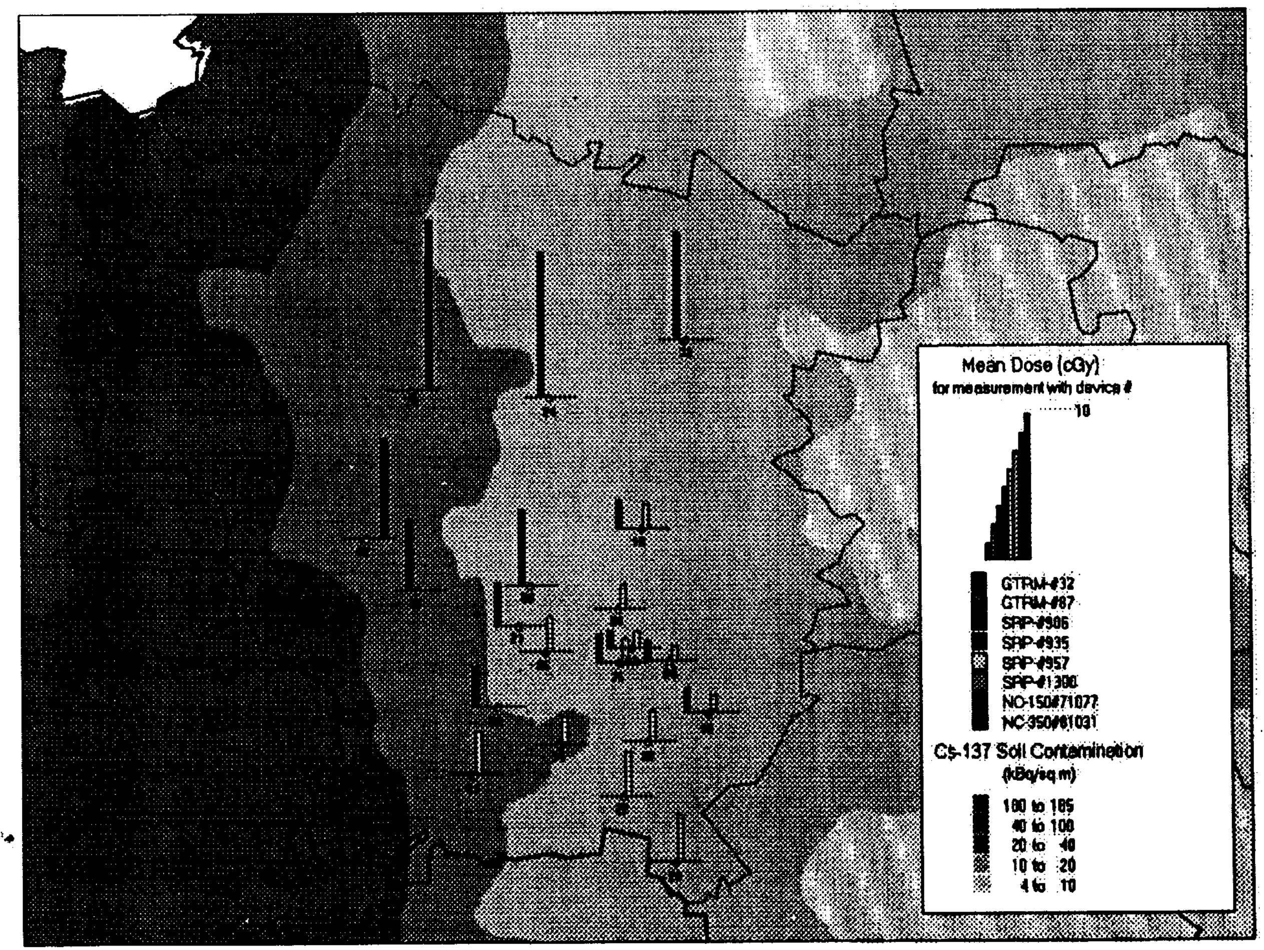

Fig. 8.15.4. Spatial distribution of device-specific mean thyroid doses for Local Council in adult age group (>18 years at exposure)

8.23. CALCULATION OF THYROID EXPOSURE DOSES FOR INHABITANTS OF 2 RAIONS FROM THE PROJECT. INCORPORATING THE INFORMATION ON DATE AND DURATION OF FALLOUT

Calculation of thyroid exposure doses was performed for those of 20,000-cohort members who were residing in Chernihiv and Narodichy raions. The date of beginning of contamination, days of radioactive ^{131}I cloud arrival, and average (for a day) specific near-ground air-born ^{131}I activity concentrations in each settlement of these raions were calculated using the Atmospheric transport model, as described in the report for the 3rd quarter of the 3rd year (December 1998 - February 1999). In order to incorporate information on the dynamics of area contamination into the procedure of dose calculation, it was necessary to modify the model of ^{131}I thyroid intake function for taking into account the multiplicity of radioiodine fallout, leaving unchanged the suggestion concerning the milk pathway of thyroid radioactivity intake.

Modified model of ^{131}I thyroid intake function

Recalculation of exposure doses taking into account the restored dynamics of atmospheric air contamination with ^{131}I in a settlement, was performed using the following equation:

$$D=\frac{k\times\sum_{j=1}^{J}Q_j}{m}=\frac{k}{m}\times\sum_{j=1}^{J}\int_0^{\infty}q_j(t)\,dt=\frac{k}{m}\times\sum_{j=1}^{J}C_{js}\,q_0\int_0^{\infty}\int_0^{t}F(t_i)\,e^{-\lambda(t-t_i)}dt_i\,dt=$$

$$=\frac{k}{m}\times\sum_{j=1}^{J}C_{js}\,q_0\int_0^{\infty}\int_{t_i}^{\infty}F(t_i)\,e^{-\lambda\times(t-t_i)}dt_i\,dt=$$

$$=\frac{k}{m}\times\sum_{j=1}^{J}C_{js}\,q_0\int_0^{\infty}F(t_i)\,e^{\lambda t_i}\left(\int_{t_i}^{\infty}e^{-\lambda t}dt\right)dt_i)=\frac{k}{m}\frac{q_0}{\lambda}\times\sum_{j=1}^{J}C_{js}\int_0^{\infty}F(t_i)\,dt_i \qquad (1)$$

where

$$q_0 = \frac{\mathrm{Act}}{\sum_{j=1}^{J} C_{js} \int_0^{t_{mj}} F(t_i)\, e^{-\lambda (t_{mj}-t_i)} dt_i} = \frac{CF\left(\frac{N_{th}}{t_{th}} - \frac{N_b}{t_b}\right)}{\sum_{j=1}^{J} C_{js} \int_0^{t_{mj}} F(t_i)\, e^{-\lambda (t_{mj}-t_i)} dt_i} \qquad (2)$$

$$F(t_i) = \left(e^{-\lambda_g t_i} - e^{-\lambda_m t_i}\right) \qquad (3)$$

where

- D= thyroid dose, Gy;
- Q_j= integrated thyroid activity due to radioiodine intake after the arrival j of radioactive cloud (μCi d);.
- k= dose conversion factor, 0.1176 (g Gy μCi^{-1} d^{-1});
- $q_j(t)$= ^{131}I thyroid content function due to radioiodine intake after the arrival j of radioactive cloud;
- C_{js}= average (for day j) specific near-ground air-born ^{131}I activity concentration above the settlement s, estimated through the Atmospheric Transport Model and the sequences of spatial queries (μCi m^{-3});
- J Number of days of arrival of radioactive clouds of fallout;
- q_0= a scaling parameter obtained from the result of measurement as (2);
- $F(t_i)$= normalized ^{131}I thyroid intake function;
- Act= thyroid activity, μCi;
- CF= calibration factor;
- N_{th}= counting from thyroid, impulses;
- t_{th}= time of measurement for thyroid, s;
- N_b= counting from background, impulses;
- t_b= time of measurement for background, s;
- λ= effective loss rate for thyroid, d^{-1};
- λ_g= effective loss rate for pasture grass, d^{-1};
- λ_m= effective loss rate for cow's milk, d^{-1};
- t_{mj}= number of days between the day j of radioactive cloud arrival and day of thyroid activity measurement;
- m= thyroid mass, g;
- t_i= integration variable

Solution of equations (1) and (2) was in a numerical form owing to software SIMULINK Matlab.

To analyze changes in dose estimates calculated using Atmospheric Transport Model (ATM), a correction ψ-factor has been introduced, which shows the relationship between the doses calculated using ATM, D_i^{pf}, and the doses calculated according to the model of prolonged intake, but without taking into account the real duration of radioactive fallout, D_i^{sf}: $\psi = \frac{D_i^{pf}}{D_i^{sf}}$.

As an example, two from the eight raions covered by the Project, have been taken: Narodychi raion of Zhytomyr oblast and Chernihiv raion of Chernihiv oblast. Narodychi raion includes 84 settlements. The calculation of radioactive fallout dynamics shows that radioiodine contamination of settlements of this raion took place on April 26-28, April 30- May 1, May 4-6. For all the settlements of the raion the first arrival of radioactive cloud took place on April 26. The number of days of arrival of radioactive clouds for different settlements of the raion varied from 3 to 7, the total time-integrated activity concentration of ^{131}I in near-ground air fluctuated from 22 to 115 MBq*s*m^{-3}.

The members of the 20,000-cohort were, on the days of arrival of radioactive clouds, in 70 from 84 settlements of Narodychi raion. For these settlements, the number of days of arrival of radioactive clouds also varied from 3 to 7 days.

Chernihiv raion includes 128 settlements. For all the settlements of this raion the first arrival of radioactive clouds took place on April 28. The number of days of arrival of radioactive clouds for different settlements of the raion was equal to 3 - 4 days, the total time-integrated activity concentration of ^{131}I in near-ground air was estimated within the range 26 to 81 MBq*s*m^{-3}.

The members of the 20,000-cohort were residing in 97 from 128 settlements of the raion. For these settlements the number of days of arrival of radioactive clouds also made 3-4 days.

Passage to a model which takes into account the real duration of radioactive fallout, leads to a decrease of dose estimates, and, therefore, to the passage of a part of the cohort under study from high-dose groups to middle- and low-dose ones. Table 8.23.1 shows the average values of correction ψ-factors for Narodychi and Chernihiv raions as well as a 90% confidence interval of their distribution.

Table 8.23.1. – Distribution of correction ψ-factor for 20.000-cohort members from the raions under study

Raion	Children aged 0-7 years			Children aged 8-18 years		
	n*	Average value ψ	90% confidence interval	n*	Average value ψ	90% confidence interval
Narodychi raion of Zhytomyr oblast	1795	0,72	[0,58;0,80]	2216	0,77	[0,65;0,83]
Chernihiv raion of Chernihiv oblast	1278	0,68	[0,53;0,76]	1530	0,72	[0,62;0,77]

* when calculating correction ψ-factor, cases of zero doses (indication of device on background level) were excluded.

Table 8.23.2 gives the number of persons for three dose groups for both raions before and after dose recalculation.

Table 8.23.2. Changes in the number of persons in dose groups when using, for dose calculation, the information on the dynamics of area contamination with ^{131}I for 20,000-cohort members

Dose group, (dose, Gy)	Narodychi raion			Chernihiv raion		
	Number of persons before re-calculation of doses	Number of persons after recalculation of doses	% of changes	Number of persons before re-calculation of doses	Number of persons after recalculation of doses	% of changes
A (0-0.3)	140	269	+93	836	1110	+33
B (0.3-1.0)	628	1052	+67	749	913	+22
C (1.0+)	3251	2698	-17	1255	817	-35

Table 8.23.3 and 8.23.4 represent in detail redistribution of the number of persons in each of dose groups for Narodychi and Chernihiv raions.

Table 8.23.3 - Changes in the composition of dose groups in 20,000-cohort members from Narodychi raion when using, for dose calculation, the data on the dynamics of area contamination with ^{131}I

Dose group prior to recalculation of doses	Dose, Gy	Number of persons	Dose groups, which acquire those measured at dose recalculation	Number of	
				Persons	in % to the initial composition of group
A	0-0.3	140	A	140	100
			B	0	0
			C	0	0
B	0.3-1.0	628	A	129	21
			B	499	79
			C	0	0
C	1.0+	3251	A	0	0
			B	553	17
			C	2698	83
Total		4019	-	4019	-

Table 8.23.4. Changes in the composition of 20,000-cohort members from Chernihiv raion when using, for dose calculation, the data on the dynamics of area contamination with ^{131}I

Dose group prior to recalculation of doses	Dose, Gy	Number of persons	Dose groups, which acquire those measured at dose recalculation	Number of	
				Persons	in % to the initial composition of group
A	0-0.3	836	A	836	100
			B	0	0
			C	0	0
B	0.3-1.0	749	A	274	37
			B	475	63
			C	0	0
C	1.0+	1255	A	0	0
			B	438	35
			C	817	65
Total		2840	-	2840	-

8.24. ESTIMATION OF THE PARAMETERS OF DOSE DISTRIBUTIONS AND OF MEASUREMENT ERRORS IN DOSIMETRY FOR THE PURPOSE OF REASSESSMENT OF THE POWER OF THE STUDIES

In the primary file provided to the DCC, 442 records did not include information on dose group. These were records, which did not contain information on the age (either in the form of year of birth or the age at the moment of activity measurements). For these records the dose was not calculated because the formula for dose calculation includes parameters depending on the age. All these data have been transferred to the DCC in the hope that in the process of search missing information could be restored.

After analysis of Table 2 (G.R.Howe. DRAFT "Studies of thyroid cancer in Belarus and Ukraine following the Chernobyl accident. A reassessment of the power of the studies"), it has been found out that Table 2 DRAFT does not represent a file of primary data provided to the DCC, but data which have been subject to processing and changes, namely:

- for records without information on dose group, the dose group and age were assigned using certain randomized procedure;
- information on gender and age was updated for December 1, 1998. According to a technology supported in DCC, if in the process of search physicians make some corrections on the spot, these are entered into the file of primary data. These corrections are intermediate ones, because after invitation to the medical examination, information - in particular, on the age - may change again. Besides, changes in age information require changes in dose assessment, and, possibly, in dose group, and to date this work has not been performed yet. For all these reasons, Table 2 DRAFT may not be restored at the moment.

Taking this into account, it has been decided to base upon primary data for estimation of parameters of dose distributions, i.e. to operate with the primary file which is stored in Dosimetry Group, and not to use procedures of random assigning of dose group and age for records with missing data on age and dose. Taking into consideration all these circumstances, Table 2 DRAFT is being transformed into Table 8.24.1.

Table 8.24.1. Ukraine: Dose Distribution As Transferred to DCC (1997)

Dose (Gray)	Gender	Age At Exposure (Years) (1986)					Total
		0-	5-	10-	15	Unknown	
0.0-	Males	2583	5039	7573	2541	0	17736
	Females	2695	5469	8304	3199	0	19667
	Unknown	1708	2562	3322	1263	0	8855
	Total	6986	13070	19199	7003	0	46258
0.3-	Males	2144	2561	2565	901	0	8171
	Females	2261	2314	2295	692	0	7562
	Unknown	1005	900	776	216	0	2897
	Total	5410	5775	5636	1809	0	18630
1.0-	Males	1879	1225	1171	385	0	4660
	Females	1836	1143	876	243	0	4098
	Unknown	656	325	201	64	0	1246
	Total	4371	2693	2248	692	0	10004
Unknown	Males	0	0	0	0	167	167
Unknown	Females	0	0	0	0	184	184
Unknown	Unknown	0	0	0	0	91	91
Unknown	Total	0	0	0	0	442	442
Total	Males	6606	8825	11309	3827	167	30734
Total	Females	6792	8926	11475	4134	184	31511
Total	Unknown	3369	3787	4299	1543	91	13089
Total	Total	16767	21538	27083	9504	442	75334

Empirical Data

Distribution of study subjects by 11 dose categories in Gy (0.0-, 0.1-, 0.2-, 0.3-, 0.4-, 0.5-, 1.0-, 2.0-, 3.0-, 5.0-, 10.0-), by gender and age at exposure (0-4, 5-9, 10-14 and 15+) was requested for reassessment of the power of the study.

Values of doses were known for 74892 subjects with known age at exposure and values of doses were unknown for 442 subjects with unknown age at exposure (Table 8.24.1). There were no unknown age at exposure values when known doses. Values of gender were unknown for a number of study subjects; specifically, there were 12998 subjects with unknown gender when known doses.

In order to use the dose data some assumptions had to be made. At first, we excluded data for those 442 subjects with unknown age at exposure , i.e. those with unknown doses. The second assumption was that those with unknown values for gender, but a known value for age at exposure, have the same gender distribution as those in that *age* and *dose* category group with known gender values.

Thus, all subjects with unknown values of gender and known doses were placed an appropriate category of gender by means of procedure of random assigning of gender with probability proportional to known numbers in Table 1 for each dose and age category. With these assumptions and corrections the distributions of dose by 11 dose categories, gender, and age at exposure are shown in Table 8.24.2.

Dose distributions

Professor G. Howe recommended to use for assessment of the parameters of dose distributions the dose categories from 0.1 Gy, and to exclude 10+ Gy category.

At a preliminary stage of assessment, selection of finer dose categories has been performed according to the criterion of correspondence to lognormal distribution on the basis of X^2 statistics. Calculated statistics are given in Table 8.24.3.

Table 8.24.2. Ukraine: Dose Distribution (with gender adjusted)

Dose (Gray)	Gender	Age At Exposure (Years) (1986)					Total
		0-	5-	10-	15	Unknown	
0.0-	Males	1562	2578	4558	1707	0	10405
	Females	1616	2950	5345	2423	0	12334
	Total	3178	5528	9903	4130	0	22739
0.1-	Males	1010	2213	3079	907	0	7209
	Females	1063	2333	3178	978	0	7552
	Total	2073	4546	6257	1885	0	14761
0.2-	Males	839	1447	1525	476	0	4287
	Females	896	1549	1514	512	0	4471
	Total	1735	2996	3039	988	0	8758
0.3-	Males	684	940	984	309	0	2917
	Females	722	901	913	261	0	2797
	Total	1406	1841	1897	570	0	5714
0.4-	Males	535	619	624	224	0	2002
	Females	554	545	604	163	0	1866
	Total	1089	1164	1228	387	0	3868
0.5-	Males	1388	1499	1361	492	0	4740
	Females	1527	1271	1150	360	0	4308
	Total	2915	2770	2511	852	0	9048
1.0-	Males	1025	742	732	264	0	2763
	Females	1020	748	582	169	0	2519
	Total	2045	1490	1314	433	0	5282
2.0-	Males	409	293	240	78	0	1020
	Females	398	268	198	41	0	905
	Total	807	561	438	119	0	1925
3.0-	Males	330	187	196	51	0	764
	Females	353	173	118	32	0	676
	Total	683	360	314	83	0	1440
5.0-	Males	251	113	96	36	0	496
	Females	249	110	59	20	0	438
	Total	500	223	155	56	0	934
10-	Males	182	41	21	1	0	245
	Females	154	18	6	0	0	178
	Total	336	59	27	1	0	423
Total	Males	8215	10672	13416	4545	0	36848
	Females	8552	10866	13667	4959	0	38044
	Total	16767	21538	27083	9504	0	74892

Table 8.24.3. Values of X^2-statistics for analysis of correspondence to lognormal distribution.

Age at exposure, years	Gender	Boundary dose categories, Gy				
		(0.1; 10)	(0.05; 10)	(0.01; 10)	(0.01; 15.0)	(0.01; 20.0)
		X^2_7	X^2_8	X^2_8	X^2_9	X^2_9
0-4	Males	149.5	57.3	35.1	66.1	72.5
	Females	161.0	66.1	44.8	61.1	70.8
5-9	Males	560.9	210.9	126.6	132.9	153.2
	Females	766.4	333.5	208.0	207.7	207.6
10-14	Males	1133.5	538.4	170.5	170.1	170.1
	Females	1195.3	616.3	136.3	137.0	137.0
15-18	Males	262.1	131.8	11.9	16.4	15.9
	Females	386.3	265.2	30.2	31.8	32.3

The first column contains X^2_7 for all age and gender combinations when excluding observations with values below 0.1Gy and above 10 Gy. The observed values of X^2_7 point out a bad agreement between the selected part of sample and the hypothesis on lognormal distribution of doses. Besides, a considerable number of measurements (near 50% in senior age groups) are found to be smaller than the left boundary, and, therefore, they are excluded from the subsequent analysis (Table 8.24.2).

The following columns of Table 8.24.3 contain X^2_8 for breaking up with additional dose category on the left, established on different levels: 0.05-0.1 Gy, 0.01-0.1 Gy. Analysis using X^2_8 statistics showed a better agreement with lognormal type of distribution when introducing an additional dose category 0.01-0.1 Gy (Table 8.24.3). The values of analogous statistics X^2_9, when introducing an additional dose category on the right 10-15 Gy or 10-20 Gy, confirms the validity of exclusion when assessing parameters of dose category 10+ Gy.

Dose distributions when introducing an additional dose category on the left on 0.01- Gy level, excluding the doses below 0.01 Gy and above 10 Gy, are given in Table 8.24.4. Table 8.24.4 was an initial one when assessing the parameters of dose distributions for each of four age groups (separately for each gender and both genders together).

Table 8.24.4. Ukraine: Dose Distribution (input date for estimation of parameters)

Dose (Gray)	Gender	Age At Exposure (Years) (1986)					Total
		0-	5-	10-	15	Unknown	
0.01-	Males	842	2038	3977	1467	0	8324
	Females	859	2292	4710	2033	0	9894
	Total	1701	4330	8687	3500	0	18218
0.1-	Males	1010	2213	3079	907	0	7209
	Females	1063	2333	3178	978	0	7552
	Total	2073	4546	6257	1885	0	14761
0.2-	Males	839	1447	1525	476	0	4287
	Females	896	1549	1514	512	0	4471
	Total	1735	2996	3039	988	0	8758
0.3-	Males	684	940	984	309	0	2917
	Females	722	901	913	261	0	2797
	Total	1406	1841	1897	570	0	5714
0.4-	Males	535	619	624	224	0	2002
	Females	554	545	604	163	0	1866
	Total	1089	1164	1228	387	0	3868
0.5-	Males	1388	1499	1361	492	0	4740
	Females	1527	1271	1150	360	0	4308
	Total	2915	2770	2511	852	0	9048
1.0-	Males	1025	742	732	264	0	2763
	Females	1020	748	582	169	0	2519
	Total	2045	1490	1314	433	0	5282
2.0-	Males	409	293	240	78	0	1020
	Females	398	268	198	41	0	905
	Total	807	561	438	119	0	1925
3.0-	Males	330	187	196	51	0	764
	Females	353	173	118	32	0	676
	Total	683	360	314	83	0	1440
5.0-	Males	251	113	96	36	0	496
	Females	249	110	59	20	0	438
	Total	500	223	155	56	0	934
Total	Males	7313	10091	12814	4304	0	34522
	Females	7641	10190	13026	4569	0	35426
	Total	14954	20281	25840	8873	0	69948

Assuming in each of age-gender categories a dose distribution according to lognormal law with parameters (μ, σ), estimates of parameters are obtained by minimizing X^2 for fixed 10 dose categories (Table 8.24.5).

Table 8.24.5. Estimates of parameters of dose distributions

Age at exposure, years	Gender	μ	σ
0-	Males	3.87	1.33
	Females	3.86	1.31
	Both gender	3.86	1.32
5-	Males	3.27	1.24
	Females	3.17	1.26
	Both gender	3.22	1.25
10-	Males	2.88	1.33
	Females	2.69	1.30
	Both gender	2.78	1.32
15-	Males	2.81	1.40
	Females	2.42	1.37
	Both gender	2.60	1.40

Measurement errors in dosimetry

According to measurement error model (G Howe, DRAFT), the observed variance of logarithms of doses (parameter σ_z^2) assumes the following representation:

$$\sigma_Z^2=\sigma_X^2+\sigma_\epsilon^2 \tag{1}$$

where

σ_Z^2- Estimated variance of logarithms of doses
σ_X^2- Variance of logarithms of true doses
σ_ϵ^2- Variance of logarithms of multiplicative error term

Having the estimate σ_{ϵ}^2, and estimate of observed $\sigma_{Z''}^2$, , we may obtain a value for σ_X^2 and, as a result, to specify the values of average doses for dose categories.

In order to study the statistical features of multiplicative error term (σ_{ϵ}^2), numerical methods for uncertainty simulation have been used.

Now, we consider the main relationships presently used for calculating individual doses according to the results of thyroid activity measurements.

Formulas for dose calculation

Three main models for dose calculation have been used.

Prolonged intake model without relocation to non-contaminated area (PIM):

$$D=k\frac{E\,Q}{m}=k\frac{E}{m}\int_0^{\infty} q(t)\ dt=k\frac{E}{m}\int_0^{\infty}\int_0^{t} q_0\,F(t_i)\,e^{-\lambda\,(t-t_i)}dt_i\,dt=k\frac{E}{m}\int_0^{\infty}\int_{t_i}^{\infty} q_0\,F(t_i)\,e^{-\lambda\times(t-t_i)}dt_i\,dt=$$

$$=k\frac{E}{m}q_0\int_0^{\infty}F(t_i)\,e^{\lambda\,t_i}\left(\int_{t_i}^{\infty}e^{-\lambda\,t}dt\right)dt_i=k\frac{E\,q_0}{m\,\lambda}\int_0^{\infty}F(t_i)\ dt_i \qquad (2)$$

The expression for q_0 is obtained from the result of activity measurement at the moment t_m: :

$$q_0=\frac{\mathrm{Act}}{\int_0^{t_m}F(t_i)\,e^{-\lambda\,(t_m-t_i)}dt_i}=\frac{K_s\left(\frac{N_{th}}{t_{th}}-\frac{N_b}{t_b}\right)}{\int_0^{t_m}F(t_i)\,e^{-\lambda\,(t_m-t_i)}dt_i} \qquad (3)$$

The function (standardized) of intake is assumed to be equal to:

$$F(t_i)=\left(e^{-\lambda_g\,t_i}-e^{-\lambda_m\,t_i}\right) \qquad (4)$$

Substituting the suggested intake function and expression for q_0 in the equation (2) for the dose, we obtain:

$$D = k\frac{E}{m}\frac{CF\left(\frac{N_{th}}{t_{th}}-\frac{N_b}{t_b}\right)}{\lambda\int_0^{t_m}\left(e^{-\lambda_g t_i}-e^{-\lambda_m t_i}\right)e^{-\lambda(t_m-t_i)}dt_i}\int_0^{\infty}\left(e^{-\lambda_g t_i}-e^{-\lambda_m t_i}\right)dt_i =$$

$$= \frac{k\,E\,CF\left(\frac{N_{th}}{t_{th}}-\frac{N_b}{t_b}\right)\left(\frac{1}{\lambda_g}-\frac{1}{\lambda_m}\right)}{m\,\lambda\left[\frac{1}{\lambda-\lambda_g}\left(e^{-\lambda_g t_m}-e^{-\lambda t_m}\right)-\frac{1}{\lambda-\lambda_m}\left(e^{-\lambda_m t_m}-e^{-\lambda t_m}\right)\right]} \quad (5)$$

where

D= thyroid dose, Gy;
Q= total number of disintegration of ^{131}I in thyroid (taken in µCi d);
E= average energy absorbed by thyroid per disintegration of ^{131}I (effective energy per disintegration of ^{131}I for all types of radiation - 0.23 MeV per decay is taken from [1];
k= coefficient connected with the measurement units; for thyroid activity in µCi (0.5115 decay g Gy μCi^{-1} MeV^{-1} d^{-1});
Act= thyroid activity at the time of measurement, µCi;
CF= calibration factor; µCi per impulses per s;
N_{th}= counting from thyroid, impulses;
t_{th}= time of measurement for thyroid, s;
N_b= counting from background, impulses;
t_b= time of measurement for background, s
λ= effective loss rate for thyroid, d^{-1};
λ_g= effective loss rate for pasture grass, d^{-1};
λ_m= effective loss rate for cow's milk, d^{-1};
t_m= time between beginning of contamination (26.04.86) and measurement of thyroid activity, d;
m= thyroid mass, g.

Prolonged intake model with relocation to non-contaminated area after 29.04.1986 (PIMWR):

In case of evacuation to non-contaminated areas, the formula for dose calculation is as follows:

$$D = k\frac{E\,Q}{m} = k\frac{E}{m}\left(\int_0^{t_r} q(t)\;dt + \int_{t_r}^{\infty} q(t)\;dt\right) =$$

$$=k\frac{E}{m}q_0\left[\int_0^{t_r}\int_0^{t}F(t_i)\,e^{-\lambda(t-t_i)}dt_i\,dt+\int_{t_r}^{\infty}\int_0^{t_r}F(t_i)\,e^{-\lambda(t_r-t_i)}\,e^{-\lambda(t-t_r)}dt_i\,dt\right] \tag{6}$$

where

t_r= time between the beginning of contamination (26.04.86) and relocation to non-contaminated area, d.

We obtain the expression for q_0 from the result of thyroid measurements at the moment t_m:

$$q_0=\frac{Act\;e^{\lambda(t_m-t_r)}}{\int_0^{t_r}F(t_i)\,e^{-\lambda(t_r-t_i)}dt_i}=\frac{CF\left(\frac{N_{th}}{t_{th}}-\frac{N_b}{t_b}\right)e^{\lambda(t_m-t_r)}}{\int_0^{t_r}F(t_i)\,e^{-\lambda(t_r-t_i)}dt_i} \tag{7}$$

The expression for the dose for the intake function (4) may be obtained in an obvious form. We will omit it because of its awkwardness.

Single intake model (SIM).

In case of evacuation to non-contaminated areas within 4 days after the accident (before April 30, 1986), one assumed a single intake of activity to thyroid, and the formula for dose calculation is as follows:

$$D=\frac{k\times Q}{m}=\frac{k}{m}\times\int_0^{\infty}q_0\;e^{-\lambda t}\,dt=\frac{q_0\,k}{m\,\lambda}=\frac{k\,Act}{m\left(1-e^{-\lambda t_m}\right)}=\frac{k\;CF\left(\frac{N_{th}}{t_{th}}-\frac{N_b}{t_b}\right)}{m\left(1-e^{-\lambda t_m}\right)} \tag{8}$$

Distribution of the number of measurements in accordance with three used models for dose calculation

Distribution of the number of measurements in accordance with the used models for dose calculation (SIM, PIM and PIMWR) is given in Table 8.24.6. For more than 80% of measurements, dose calculation has been performed according to PIM model; therefore, further analysis of uncertainty is made for conditions of PIM use.

Table 8.24.6. Distribution of the measurements by age groups and models for dose calculation

Age, years	Number of measurements		
	SIM	PIM	PIMWR
0-4	479	15739	549
5-9	1104	18267	2167
10-14	2220	19989	4874
15-18	873	6740	1891
Total	4676	60735	9481

Formulas for representation of parameters of PIM model and assumption oftheir statistical features

The following formula is used for the parameter λ_g:

$$\lambda_g = \frac{\log(2)}{T_w} + \frac{\log(2)}{T_g} + \frac{\log(2)}{T_r} \tag{9}$$

where

T_w= weathering half-life for grass (d) ;
T_g= half-life due to growth dilution in May (d);
T_r= half-life due to ^{131}I radiological decay, 8.04 d.

The following formula is used for the parameter λ_m:

$$\lambda_m = \frac{\log(2)}{T_m} + \frac{\log(2)}{T_r} \tag{10}$$

where

T_m= biological half-life for milk (d) ;
T_r= half-life due to ^{131}I radiological decay, 8.04 d.

The following formula is used for the parameter λ:

$$\lambda = \frac{\log(2)}{T_b} + \frac{\log(2)}{T_r} \tag{11}$$

where

T_b= biological half-life for iodine in thyroid (d) ;
T_r= half-life due to ^{131}I radiological decay, 8.04 d.

Assumptions of statistical features of parameters T_w, T_g, [2], and T_m [3] used for modelling, are given in Table 8.24.7.

For the parameter T_b a lognormal distribution is assumed, with arithmetic mean=44 d (for 8-12 y) according to [3], and variance which is deduced from the work [4] with assumption of an identical (for all ages) coefficient of variation of logarithms T_b, equal to 30% (Table 8.24.7).

For the parameter m a lognormal distribution is assumed, and an estimate of arithmetic mean=8 g and coefficient of variation=40% for Ukrainian thyroid masses [5] are used.

The following formula is used for the parameter CF:

$$CF = K_s \frac{K_{ov}}{K_m} \tag{12}$$

where

K_s= calibration coefficient for device using the measurements of reference source;
K_{ov}= correction factor for calibration coefficient to account reducing of gamma irradiation due to the thickness of overlying tissue
K_m= correction factor for calibration coefficient to account reducing of gamma irradiation due to the self-absorption in thyroid

For the parameter K_{ov} a triangular distribution is assumed, with mode 1.13, minimum value 1.06 and maximum one 1.15 [5] (Table 8.24.7).

For the parameter K_m one assumes a triangular distribution with mode 1, minimum value equal to 0.85 and maximum one 1.14, as estimated according to the data published in [5] (Table 8.24.7).

Table 8.24.7 Assuming distribution of the sensitive parameters for the calculation of the range of uncertainty for individual dose

Parameter	Distribution	μ (σ) or mean (SD) or mode	Minimum	Maximum
T_w-Weathering half-life for grass (d)	Triangular	25.0[a]	15	30
T_g-Half-life due to growth dilution in May (d)	Triangular	18.0[a]	13.0	23.0
T_m-Biological half-life for milk (d)	Triangular	1.28[a]	0.7	1.3
T_b-Iodine biological half-life for thyroid (d)	Lognormal	3.29 (0.99)[b]		
m – Thyroid mass	Lognormal	2.00 (0.39)[b]		
K_{ov} – correction factor for attenuation of photons by overlying tissue (dimensionless)	Triangular	1.13[a]	1.06	1.15
K_m– correction factor for attenuation of photons by thyroid tissue (dimensionless)	Triangular	1[a]	0.85	1.14
K_s – calibration factor obtained with control source (μCi h per μR)	Uniform	$6.25*10^{-3}$	$2.06*10^{-3}$	$10.7*10^{-3}$
P_{th} – gamma dose rate over the thyroid (μR per h)	Normal	135 (2.89)[c]		
P_b– background gamma dose rate (μR per h)	Normal	42 (1.61)[c]		
K_{er_th}– reading error when measuring P_{th}	Uniform	0	+2.5	-2.5[d]
K_{er_b}– reading error when measuring P_b	Uniform	0	+1[e]	-1[e]
t_m – day of measurement since 26.04.86	Const	28		

[a] Value represents the mode value for the triangular distribution.

[b] μ and σ are the mean and standard deviation, respectively, of logtransformed data.

[c] mean and standard deviation, respectively, of normal distributed data.

For the parameter K_s it is assumed to be a random variable if, for dose calculation, one used a unique average (for all SRP-68-01 devices) calibration coefficient (calibration Class 3, Table 8.15.1, Second quarter of report, 1998) equal to 6.25 10^{-3} μCi h per μR. In such cases, we consider that since we do not know the true K_s, it may have, with an equal probability, values in a range limited by variability of known K_s for SRP-68-01 devices in Ukraine: 2.06*10^{-3} to 10.72*10^{-3} μCi h per μR. The transition from K_s in μCi h per μR for SRP-68-01 to K_s in μCi s per impulses is realized using the coefficient 3.226 impulses h per μR s.

For measurements which were made with devices having been calibrated in the process of measurement or before the process of measurement (calibration Class 1 and Class 2, Table 8.15.1, Second quarter of report, 1998), the parameter K_s is assumed to be a determinate value. Thus, K_s is assumed to be a random variable for non-spectrometric measurements without calibration, and a determinate one for all spectrometric and non-spectrometric measurements with calibration (Table 8.24.8).

Table 8.24.8. Distribution of results for the parameter K_s

Age, year	SIM		PIM		PIMWR	
	Random *CF*	Determinate *CF*	Random *CF*	Determinate *CF*	Random *CF*	Determinate *CF*
0-4	56	423	8213	7526	38	511
5-9	487	617	9670	8597	546	1621
10-14	1776	444	9245	10744	1584	3290
15-18	656	217	3203	3537	643	1248
Total	2975	1701	30331	30404	2811	6670

For the most numerous group of measurements calculated according to PIM model, the results in which K_s is assumed to be a random variable, represent 50%. Just for the results of measurements with SRP-68-01, calculated according to PIM model, for which the true value of K_s is unknown, measurement error (uncertainty) is calculated furtherly, assuming K_s to be a random variable.

Table 8.24.9 gives the average days of measurement (beginning from April 26, 1986) for a selected group of measurements using SRP-68-01 device for different age groups and ranges of dose categories. For simulation one uses t_m=28 day after the beginning of contamination (May24) as average day of measurements with SRP-68-01 devices with unknown K_s, , for inhabitants who have not moved to non-contaminated areas and for dose categories within the range 0.01 to 10 Gy.

Table 8.24.9. Estimates of parameters t_m, P_{th} and P_b for different age groups and thyroid doses (the results of calculations according to PIM model with a parameter K_s, not known exactly and assumed to be a random variable)

Dose, Gy	Parameter	Age at exposure, years				Avarage for all ages
		0-4	5-9	10-14	15-18	
0.01-10	N	6483	7823	9970	3339	27615
	P_{th}	108	124	152	170	135
	P_b	43	41	41	47	42
	t_m	28	28	27	29	28
0.1-10	N	6252	7162	8234	2446	24094
	P_{th}	111	133	179	221	151
	P_b	43	41	43	52	43
	t_m	28	28	27	29	28
>=0.01 And <0.1	N	231	661	1736	893	3521
	P_{th}	38	44	47	51	47
	P_b	34	36	33	36	35
	t_m	28	28	28	30	28
<0.01	N	528	354	287	109	1278
	P_{th}	55	67	47	69	58
	P_b	71	81	56	111	74
	t_m	36	33	28	31	33

Detected values for measurements with SRP device are: gamma dose rate above the thyroid P_{th} (μR per h) and gamma dose rate in the room without the patient P_b (μR per h) which are connected with an estimate of intensity of Poisson number of decays (N_{th}/t_{th}) by the following ratio:

$$P_{th} = \frac{\frac{N_{th}}{t_{th}}}{3.226}$$

where

N_{th}/t_{th}= an estimate of intensity of Poisson number of decays, impulses per s;
3.226= the coefficient of transition from μR per h to impulses per s for measurements of ^{131}I using SRP-68-01 (impulses h per μR s).

For the parameters P_{th} and P_b a normal distribution is assumed. We find the average of this distribution from the results of measurements as average readings of SRP devices when measuring the thyroid and background in the selected group of measurements by SRP devices (Table 8.24.9).

The data of Table 8.24.9 confirm the possibility of including the dose range 0.01- Gy in the analysis, and the necessity of excluding from it the doses below 0.01 Gy, because only for the doses below 0.01 Gy the average $P_{th}<P_b$.

Variance of parameters P_{th} and P_b is deduced from the assumption of Poisson character of distribution N_{th} and N_b :

$$N \cong \text{Poisson}(\lambda t), \quad \lambda = \frac{N}{t}$$

Hence we have variance for P:

$$\sigma_P^2 = \frac{\lambda t}{t^2 3.226^2} = \frac{N}{t^2 3.226^2} = \frac{P}{t 3.226}$$

The time of measurement t_{th} and t_b was automàtically established in the process of measurements with SRP-68-01 and was equal to 5 s.

SRP-68-01 device represents a pointer device with five scales of ranges of measurement. Reading of results is associated with a reading error K_{er} which is an additive one and is uniform distributed in the interval determined by the value of division of the scale used. The estimates of the maximum absolute and relative reading error for each scale are given in Table 8.24.10.

Table 8.24.10. Reading errors for SRP-68-01 devices

Range, μR per h	Scale-division value, μR per h	Maximum absolute reading error, μR per h	Maximum relative reading error
10-30	0.5	0.25	2.50%
30-100	2	1	3.33%
100-300	5	2.5	2.50%
300-1000	20	10	3.33%
1000-3000	50	25	2.50%

Finally, the formula (5) for modelling an individual dose and its uncertainty for the most numerous group of results of measurements (using SRP-68-01 with a K_s which is not known exactly and dose calculation according to PIM model) is as follows:

$$D(\mathrm{Gy})=\frac{0.1176K_s\frac{K_{ov}}{K_m}\left[(P_{th}+K_{er\_th})-(P_b+K_{er\_b})\right]\left(\frac{1}{\lambda_g}-\frac{1}{\lambda_m}\right)}{m\lambda\left[\frac{1}{\lambda-\lambda_g}\left(e^{-\lambda_g t_m}-e^{-\lambda t_m}\right)-\frac{1}{\lambda-\lambda_m}\left(e^{-\lambda_m t_m}-e^{-\lambda t_m}\right)\right]} \quad (10)$$

We consider the model in question as a model which gives the highest uncertainty in the assessment of individual dose (because of the random value of the parameter K_s) in the framework of the used model of intake function. For the model in question the influence of uncertainty in the parameters used was studied; at the same time the uncertainty connected with a possible inadequacy of the model of intake function (model uncertainty) were not taken into consideration at this stage.

As a numerical procedure for modelling the distribution of infividual errors, Monte Carlo technique has been used, namely the generation of error distribution on the basis of samples from multidimensional distribution of the vector of model's parameters (simple random sampling process). Probabilistic features of each of model's parameters are gathered in Table 8.24.7.

At this stage, we assume the statistical and functional relation (significant correlation) between the values of model's parameters to be absent.

Because of lack, inacessibility of specialized software for the procedure of probabilistic modelling, Monte Carlo technique is realized using software Matlab (MATLAB Statistics Toolbox).

Estimates of True Mean doses in dose categories

The realized procedure provided for modelling n=50000 samples for the vector of parameters and calculation of dose estimates for each value of the vector of parameters. The histogram of distribution of modelled logarithms of measurement errors is given on Fig.8.24.1. As appears from Fig.8.24.1, the modelled distribution is in good agreement with normal distribution. Using symbols from (G.R. Howe, DRAFT), the parameter SD of this distribution of multiplicative error term for individual dose log(GSD)=0.648. The results obtained correspond to the model for individual measurements. In particular, under conditions of the above model, the value 0.648 may be taken as a preliminary estimate of log(GSD) errors of individual measurements (not differentiated by gender, age category, period of measurement, etc.). For an advanced study of features of errors as a function of certain factors, an additional study is necessary on the basis of analogous approaches.

The estimated value of log(GSD) was used to obtain true mean doses (G.Howe, DRAFT) for the dose categories in question (Table 8.24.11). Assuming that the results of individual measurements with devices with calibration (in the process of measurement or before it) have a measurement error smaller than that estimated for SRP-68-01 without calibration, the values of true mean doses were calculated for log(GSD)=0.75*0.648 (Table 8.24.12). Taking into consideration that this model of dose calculation did not take into account the contribution of ^{137,134}Cs into the signal registered from the thyroid, what may increase the measurement error, the values of true mean doses were calculated for log(GSD)=1.25*0.648 (Table 8.24.13).

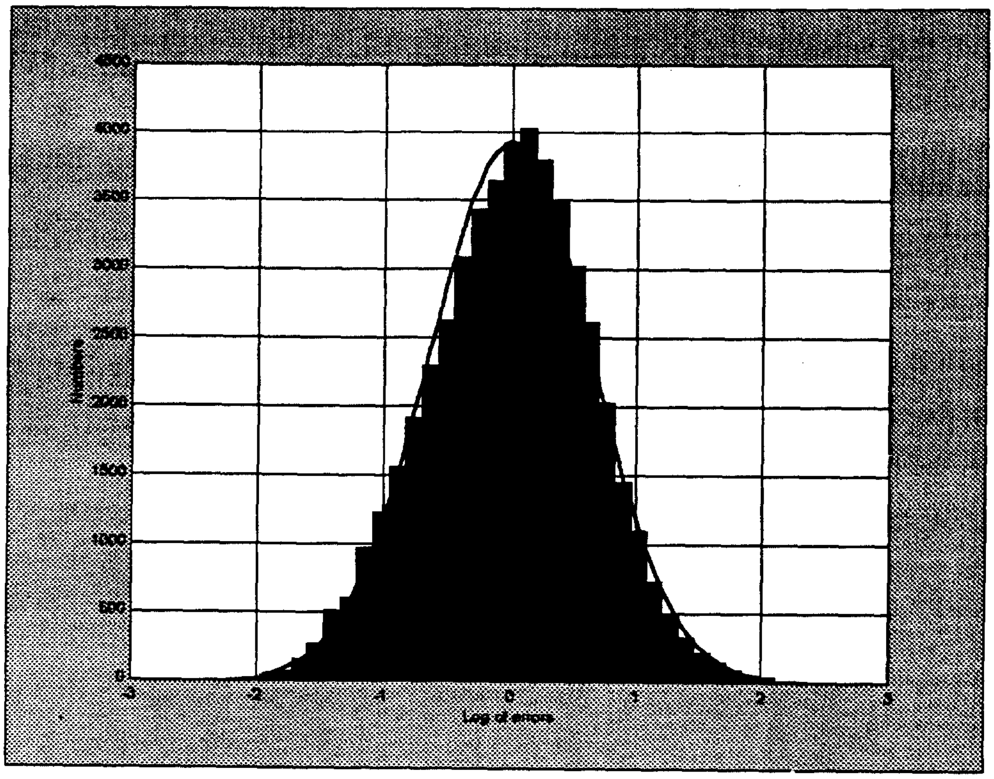

Fig.8.24.1. Histogram of distribution of logarithms multiplicative errors (for PIM, measurements with SRP-68-01, calibration Class 3) as result of Monte Carlo simulation. Normal probability density function is plotted for comparison.

Table 8.24.11 Values of true mean doses for dose categories for log(GSD)=0.648

Dose (Gray)	Gender	True mean dose (Gy) for Age-At-Exposure-category (years) (1986)			
		0-	5-	10-	15
0.01-	Males	0.081	0.080	0.072	0.068
	Females	0.082	0.078	0.070	0.063
	Both	0.081	0.079	0.071	0.065
0.1-	Males	0.158	0.154	0.147	0.146
	Females	0.159	0.152	0.145	0.142
	Both	0.159	0.153	0.146	0.144
0.2-	Males	0.251	0.247	0.244	0.244
	Females	0.252	0.246	0.243	0.242
	Both	0.252	0.247	0.244	0.243
0.3-	Males	0.349	0.346	0.344	0.345
	Females	0.349	0.345	0.343	0.343
	Both	0.349	0.346	0.344	0.344
0.4-	Males	0.448	0.445	0.445	0.445
	Females	0.448	0.445	0.443	0.443
	Both	0.448	0.445	0.444	0.444
0.5-	Males	0.698	0.649	0.646	0.654
	Females	0.696	0.647	0.631	0.633
	Both	0.697	0.648	0.639	0.646
1.0-	Males	1.320	1.223	1.233	1.256
	Females	1.313	1.224	1.205	1.219
	Both	1.316	1.223	1.221	1.242
2.0-	Males	2.354	2.278	2.295	2.318
	Females	2.347	2.281	2.272	2.288
	Both	2.350	2.279	2.286	2.308
3.0-	Males	3.575	3.410	3.456	3.510
	Females	3.557	3.420	3.408	3.448
	Both	3.566	3.415	3.437	3.490
5.0-	Males	5.958	5.614	5.722	5.848
	Females	5.910	5.636	5.629	5.717
	Both	5.933	5.625	5.683	5.807

Table 8.24.11 Values of true mean doses for dose categories for log(GSD)=0.486

Dose (Gray)	Gender	True mean dose (Gy) for Age-At-Exposure-category (years) (1986)			
		0-	5-	10-	15
0.01-	Males	0.075	0.073	0.065	0.062
	Females	0.075	0.071	0.064	0.058
	Both	0.075	0.072	0.064	0.059
0.1-	Males	0.154	0.150	0.146	0.145
	Females	0.154	0.149	0.145	0.143
	Both	0.154	0.150	0.145	0.144
0.2-	Males	0.250	0.247	0.245	0.245
	Females	0.250	0.247	0.244	0.243
	Both	0.250	0.247	0.245	0.244
0.3-	Males	0.349	0.346	0.345	0.346
	Females	0.349	0.346	0.345	0.344
	Both	0.349	0.346	0.345	0.345
0.4-	Males	0.448	0.446	0.446	0.446
	Females	0.448	0.446	0.445	0.445
	Both	0.448	0.446	0.445	0.446
0.5-	Males	0.706	0.674	0.669	0.674
	Females	0.705	0.672	0.659	0.659
	Both	0.705	0.673	0.664	0.668
1.0-	Males	1.359	1.291	1.292	1.308
	Females	1.355	1.290	1.271	1.278
	Both	1.357	1.290	1.283	1.296
2.0-	Males	2.391	2.342	2.349	2.362
	Females	2.387	2.343	2.332	2.341
	Both	2.389	2.342	2.342	2.355
3.0-	Males	3.681	3.560	3.585	3.621
	Females	3.669	3.564	3.547	3.571
	Both	3.674	3.562	3.569	3.604
5.0-	Males	6.280	5.953	6.038	6.146
	Females	6.242	5.970	5.943	6.017
	Both	6.260	5.961	5.999	6.104

Table 8.24.11 Values of true mean doses for dose categories for log(GSD)=0.81

Dose (Gray)	Gender	True mean dose (Gy) for Age-At-Exposure-category (years) (1986)			
		0-	5-	10-	15
0.01-	Males	0.087	0.087	0.079	0.075
	Females	0.088	0.085	0.078	0.070
	Both	0.088	0.086	0.078	0.072
0.1-	Males	0.166	0.161	0.149	0.147
	Females	0.168	0.157	0.145	0.140
	Both	0.167	0.159	0.147	0.143
0.2-	Males	0.255	0.248	0.243	0.243
	Females	0.255	0.246	0.240	0.239
	Both	0.255	0.247	0.241	0.241
0.3-	Males	0.350	0.344	0.342	0.343
	Females	0.351	0.343	0.339	0.339
	Both	0.351	0.344	0.341	0.341
0.4-	Males	0.449	0.443	0.442	0.443
	Females	0.449	0.443	0.440	0.440
	Both	0.449	0.443	0.441	0.442
0.5-	Males	0.683	0.606	0.608	0.622
	Females	0.679	0.605	0.589	0.596
	Both	0.680	0.605	0.599	0.612
1.0-	Males	1.252	1.132	1.152	1.184
	Females	1.240	1.136	1.125	1.144
	Both	1.245	1.134	1.140	1.169
2.0-	Males	2.286	2.177	2.211	2.247
	Females	2.274	2.184	2.181	2.208
	Both	2.280	2.180	2.198	2.235
3.0-	Males	3.410	3.230	3.291	3.358
	Females	3.384	3.243	3.244	3.292
	Both	3.397	3.237	3.272	3.338
5.0-	Males	5.586	5.320	5.419	5.532
	Females	5.540	5.340	5.350	5.430
	Both	5.562	5.330	5.391	5.502

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Table 1. Screening activities in May 1999

	Raion	Appointments made	Screened	%
Mobile teams	Chernihiv	220	184	83

Tabl.2 Number of people screened on 01.06.1999

№	Raion	Totally in 20,000 cohort	Found and live in raion	Were examined		
				N	% of number of found	% of number of members of 20000 cohort
1	Ivankiv	747	581	145	24	19
2	Former Chornobyl raion Gornostaypol selsky sovet	84	0	37	-	44
3	Ovruch	3073	1672	770	46	25
4	Narodichi	4277	985	426	43	10
5	Kozelets	2089	1157	612	53	29
6	Kyiv	-	412	333	81	-
7	Brusilov	-	89	67	75	
8	Chernigov	2857	1498	361	24	13
9	Repky	1377	898	460	46	30
10	City of Chernihiv	1192	407	184	45	15
Total			7699	3395		

Screening examinations by mobile medical teams of cohort members residing in Ripky raion of Chernihiv oblast have been organized 460 participants have been examined.

1.20 To establish contacts with theMain Departments of the Ministry of Internal Affairs of Ukraine, of Zhytomyr and other oblasts of Ukraine concerning implementation of the instructions No. 10/6-4680 of the Ministry of Internal Affairs of Ukraine dated November 30, 1998.

Contacts have been established with the Main Departments of the Ministry of Internal Affairs of Ukraine in Chernihiv and Zhytomyr oblasts, and City of Kyiv (Departments of passport registration and migration issues). As a result of the work performed, the addresses of 2500 potential cohort members have been additionally established: for Chernihiv oblast 1300 participants; for Zhytomyr oblast 600 participants; for the City of Kyiv 600 participants.

1.21 To organize and hold a regular joint meeting devoted to issues of Project implementation (with participation of the Ministry of Public Health of Ukraine, Project's Management and executors.

Because of a staff meeting planned by the Minister of Public Health for July 26, 1999, with hearing the account on Project implementation and involvement of all executors and coexecutors, the regular joint meeting devoted to the issues of Project implementation was adjourned till July 1999.

1.22 To organize and hold a meeting with medical staff of controlled raions, who are responsible for searching cohort members and their involvement in screening examinations.

Meetings have been held with medical workers of controlled raions of Chernihiv and Zhytomyr oblasts, who are responsible for search of cohort members and their involvement in the screening.